



**STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION**

**NOTICE TO BIDDERS  
AND  
SPECIAL PROVISIONS**

**FOR CONSTRUCTION ON STATE HIGHWAY IN SAN MATEO AND SANTA CLARA  
COUNTIES AT VARIOUS LOCATIONS**

**In District 04 On Routes 82, 84, 101, 109, 114**

**Under**

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**Bid book dated November 19, 2012**

**Standard Specifications dated 2006**

**Project Plans approved August 27, 2012**

**Standard Plans dated 2006**

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**Identified by**

**Contract No. 04-4A9254**

**04-SM,SCI-82, 84, 101, 109, 114-Var**

**Project ID 0412000451**

**Electronic Advertising Contract**

Bids open Wednesday, December 19, 2012

Dated November 19, 2012

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# SPECIAL NOTICES

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- Effective July 6, 2010, the Department will receive bids for projects in Districts 1 through 6, 9, and 10 at 1727 30th Street, Bidders' Exchange, MS 26, Sacramento, CA 95816. Refer to the Notice to Bidders for this project's bid opening date, time, and location.
- Refer to Section 8-1.07, "Liquidated Damages," of the Amendments to the Standard Specifications for your project-specific liquidated damages based on your total bid.
- The Department has changed its DVBE requirements. Refer to section titled "Disabled Veteran Business Enterprises" in Section 2, "Bidding," of these special provisions.
- The Department is providing an electronic Information Handout for this project. Refer to Section 2-1.03B, "Supplemental Project Information," in the Amendments to the Standard Specifications for the location of this information.
- The Department is allowing contractors to submit electronic payroll records to the District Labor Compliance Office. Refer to section titled "Electronic Submission of Payroll Records" under Section 5, "General," of these special provisions.

## CONTRACT NO. 04-4A9254

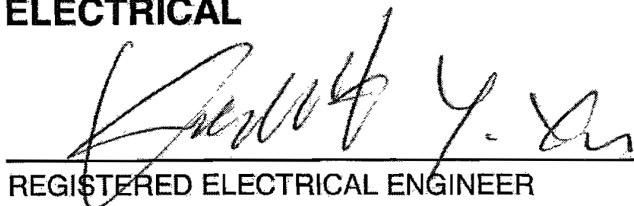
The special provisions contained herein have been prepared by or under the direction of the following Registered Persons.

### DESIGN

  
Registered Civil Engineer



### ELECTRICAL

  
REGISTERED ELECTRICAL ENGINEER



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# STANDARD PLANS LIST

The Standard Plan sheets applicable to this contract include, but are not limited to those indicated below. Applicable Revised Standard Plans (RSPs) and New Standard Plans (NSPs) indicated below are included in the project plans as Standard Plan sheets.

|            |   |
|------------|---|
| A10A       | Acronyms and Abbreviations (Sheet 1 of 2)   |
| A10B       | Acronyms and Abbreviations (Sheet 2 of 2)   |
| A10C       | Symbols (Sheet 1 of 2)  |
| A10D       | Symbols (Sheet 2 of 2)  |
| RSP A77A1  | Metal Beam Guard Railing – Standard Railing Section (Wood Post with Wood Block)           |
| A77B1      | Metal Beam Guard Railing – Standard Hardware  |
| A77C1      | Metal Beam Guard Railing – Wood Post and Wood Block Details                               |
| RSP A77C3  | Metal Beam Guard Railing – Typical Line Post Embedment and Hinge Point Offset Details     |
| RSP A77C4  | Metal Beam Guard Railing – Typical Railing Delineation and Dike Positioning Details       |
| NSP A77C5  | Metal Beam Guard Railing – Typical Vegetation Control Standard Railing Section            |
| NSP A77C6  | Metal Beam Guard Railing – Typical Vegetation Control for Terminal System End Treatments  |
| NSP A77C7  | Metal Beam Guard Railing – Typical Vegetation Control at Structure Approach and Departure |
| NSP A77C8  | Metal Beam Guard Railing – Typical Vegetation Control at Fixed Object                     |
| NSP A77C9  | Metal Beam Guard Railing – Typical Vegetation Control at Fixed Object                     |
| NSP A77C10 | Metal Beam Guard Railing – Typical Vegetation Control at Fixed Object                     |
| RSP A77G3  | Metal Beam Guard Railing – Typical Layouts for Roadside Fixed Objects                     |
| RSP A77H1  | Metal Railing – End Anchor Assembly (Type SFT)  |
| A77L1      | Metal Beam Railing – Terminal System (Type SRT)   |
| A77L5      | Metal Beam Railing – Terminal System (Type FLEAT)   |
| RSP T1A    | Temporary Crash Cushion, Sand Filled (Unidirectional)                                     |
| RSP T1B    | Temporary Crash Cushion, Sand Filled (Bidirectional)                                      |
| RSP T2     | Temporary Crash Cushion, Sand Filled (Shoulder Installations)                             |
| T3         | Temporary Railing (Type K)  |
| NSP T3A    | Temporary Railing (Type K)  |
| T10        | Traffic Control System for Lane Closure On Freeways and Expressways                       |
| T11        | Traffic Control System for Lane Closure on Multilane Conventional Highways                |
| T12        | Traffic Control System for Lane Closure on Multilane Conventional Highways                |
| T13        | Traffic Control System for Lane Closure on Two Lane Conventional Highways                 |
| T14        | Traffic Control System for Ramp Closure   |
| T59        | Temporary Water Pollution Control Details (Temporary Concrete Washout Facility)           |
| RS1        | Roadside Signs, Typical Installation Details No. 1  |
| RS2        | Roadside Signs – Wood Post, Typical Installation Details No. 2                            |
| RS4        | Roadside Signs, Typical Installation Details No. 4  |
| S48        | Overhead Signs – Lightweight Post Details   |
| S49        | Overhead Signs – Lightweight Foundation Details   |
| S93        | Framing Details for Framed Single Sheet Aluminum Signs, Rectangular Shape                 |
| S94        | Roadside Framed Single Sheet Aluminum Signs, Rectangular Shape                            |
| S95        | Roadside Single Sheet Aluminum Signs, Diamond Shape                                       |
| RSP ES-1A  | Electrical Systems (Symbols and Abbreviations)  |
| RSP ES-1B  | Electrical Systems (Symbols and Abbreviations)  |
| RSP ES-1C  | Electrical Systems (Symbols and Abbreviations)  |
| ES-3A      | Electrical Systems (Controller Cabinet Details)   |
| ES-3B      | Electrical Systems (Controller Cabinet Details)   |
| ES-3C      | Electrical Systems (Controller Cabinet Details)   |
| RSP ES-3E  | Electrical Systems (Telephone Demarcation Cabinet, Type B)                                |
| RSP ES-4D  | Electrical Systems (Signal Heads and Mountings)   |
| RSP ES-5A  | Electrical Systems (Detectors)  |



|            |  |
|------------|--|
| ES-5B      | Electrical Systems (Detectors)   |
| ES-5D      | Electrical Systems (Detectors)   |
| ES-7M      | Electrical Systems (Signal and Lighting Standards – Details No. 1)         |
| ES-7N      | Electrical Systems (Signal and Lighting Standards – Details No. 2)         |
| NSP ES-8A  | Electrical Systems (Pull Box)  |
| NSP ES-8B  | Electrical Systems (Traffic Rated Pull Box)                                |
| ES-11      | Electrical Systems (Foundation Installations)                              |
| ES-12A     | Electrical Systems (Pedestrian Overcrossing Fluorescent Lighting Fixture)  |
| ES-12B     | Electrical Systems (Pedestrian Undercrossing Fluorescent Lighting Fixture) |
| RSP ES-14C | Electrical Systems (Extinguishable Message Sign and Flashing Beacons)      |
| ES-16A     | Electrical Systems (Closed Circuit Television, Pole Details)               |

## **CANCELED STANDARD PLANS LIST**

The Standard Plan sheets listed below are canceled and not applicable to this contract.

|         |                              |
|---------|------------------------------|
| NSP P31 | Canceled on June 5, 2009     |
| D97B    | Canceled on June 6, 2008     |
| NSP H54 | Canceled on July 31, 2009    |
| ES-8    | Canceled on January 20, 2012 |
| ES-10   | Canceled on July 20, 2012    |



# NOTICE TO BIDDERS

Bids open Wednesday, December 19, 2012

Dated November 19, 2012

General work description: Install traffic system infrastructure.

The Department will receive sealed bids for CONSTRUCTION ON STATE HIGHWAY IN SAN MATEO AND SANTA CLARA COUNTIES AT VARIOUS LOCATIONS.

District-County-Route-Post Mile: 04-SM,SCI-82, 84, 101, 109, 114-Var

Contract No. 04-4A9254

The Contractor must have either a Class A license or one of the following Class C licenses: C-10.

The Department establishes no DVBE Contract goal but encourages bidders to obtain DVBE participation.

Bids must be on a unit price basis.

Complete the work within 200 working days.

The estimated cost of the project is \$6,100,000.

No prebid meeting is scheduled for this project.

The Department will receive bids until 2:00 p.m. on the bid open date at 1727 30th Street, Bidders' Exchange, MS 26, Sacramento, CA 95816. Bids received after this time will not be accepted. Department staff will direct the bidders to the bid opening.

The Department will open and publicly read the bids at the above location immediately after the specified closing time.

District office addresses are provided in the Standard Specifications.

Present bidders' inquiries to the Department and view the Department's responses at:

[http://www.dot.ca.gov/hq/esc/oe/project\\_status/bid\\_inq.html](http://www.dot.ca.gov/hq/esc/oe/project_status/bid_inq.html)

Questions about alleged patent ambiguity of the plans, specifications, or estimate must be asked before bid opening. After bid opening, such questions will not be treated as bid protests.

Submit your bid with bidder's security equal to at least 10 percent of the bid.

Under Govt Code § 14835 et seq. and 2 CA Code of Regs § 1896 et seq., the Department gives preference to certified small businesses and non-small businesses who commit to 25 percent certified small business participation.

Under Pub Cont Code § 6107, the Department gives a reciprocal preference to a California company for bid comparison purposes over a nonresident contractor from any state that provides a preference to contractors from that state on construction contracts.

Prevailing wages are required on this Contract. The Director of the California Department of Industrial Relations determines the general prevailing wage rates. Obtain the wage rates at the DIR Web site, <http://www.dir.ca.gov>, or from the Department's Labor Compliance Office of the district in which the work is located.

The Department has made available Notices of Suspension and Proposed Debarment from the Federal Highway Administration. For a copy of the notices go to [http://www.dot.ca.gov/hq/esc/oe/contractor\\_info](http://www.dot.ca.gov/hq/esc/oe/contractor_info). Additional information is listed in the Excluded Parties List System at <https://www.epls.gov>.

DEPARTMENT OF TRANSPORTATION

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### COPY OF BID ITEM LIST

| Item No. | Item Code | Item Description   | Unit of Measure | Estimated Quantity |
|----------|-----------|--|-----------------|--------------------|
| 1        | 070012    | PROGRESS SCHEDULE (CRITICAL PATH METHOD)                 | LS              | LUMP SUM           |
| 2        | 074016    | CONSTRUCTION SITE MANAGEMENT                             | LS              | LUMP SUM           |
| 3        | 074017    | PREPARE WATER POLLUTION CONTROL PROGRAM                  | LS              | LUMP SUM           |
| 4        | 090100    | TIME-RELATED OVERHEAD (WDAY)                             | WDAY            | 200                |
| 5        | 120090    | CONSTRUCTION AREA SIGNS                                  | LS              | LUMP SUM           |
| 6        | 120100    | TRAFFIC CONTROL SYSTEM                                   | LS              | LUMP SUM           |
| 7        | 128652    | PORTABLE CHANGEABLE MESSAGE SIGN (LS)                    | LS              | LUMP SUM           |
| 8        | 130900    | TEMPORARY CONCRETE WASHOUT                               | LS              | LUMP SUM           |
| 9        | 148005    | NOISE MONITORING   | LS              | LUMP SUM           |
| 10       | 153103    | COLD PLANE ASPHALT CONCRETE PAVEMENT                     | SQYD            | 16,400             |
| 11       | 160102    | CLEARING AND GRUBBING (LS)                               | LS              | LUMP SUM           |
| 12       | 190110    | LEAD COMPLIANCE PLAN                                     | LS              | LUMP SUM           |
| 13       | 202011    | MULCH  | CY              | 1                  |
| 14       | 390132    | HOT MIX ASPHALT (TYPE A)                                 | TON             | 2,760              |
| 15       | 397005    | TACK COAT  | TON             | 17                 |
| 16       | 560249    | FURNISH SINGLE SHEET ALUMINUM SIGN (0.080"-UNFRAMED)     | SQFT            | 140                |
| 17       | 561003    | 24" CAST-IN-DRILLED-HOLE CONCRETE PILE (SIGN FOUNDATION) | LF              | 160                |
| 18       | 561004    | 30" CAST-IN-DRILLED-HOLE CONCRETE PILE (SIGN FOUNDATION) | LF              | 44                 |
| 19       | 568001    | INSTALL SIGN (STRAP AND SADDLE BRACKET METHOD)           | EA              | 14                 |
| 20       | 820118    | GUARD RAILING DELINEATOR                                 | EA              | 24                 |

| Item No. | Item Code | Item Description  | Unit of Measure | Estimated Quantity |
|----------|-----------|---|-----------------|--------------------|
| 21       | 832003    | METAL BEAM GUARD RAILING (WOOD POST)  | LF              | 300                |
| 22       | 832070    | VEGETATION CONTROL (MINOR CONCRETE)   | SQYD            | 130                |
| 23       | 839581    | END ANCHOR ASSEMBLY (TYPE SFT)  | EA              | 8                  |
| 24       | 839585    | ALTERNATIVE FLARED TERMINAL SYSTEM  | EA              | 8                  |
| 25       | 860090    | MAINTAINING EXISTING TRAFFIC MANAGEMENT SYSTEM ELEMENTS DURING CONSTRUCTION | LS              | LUMP SUM           |
| 26       | 860812    | MICROWAVE VEHICLE DETECTION SYSTEM  | EA              | 9                  |
| 27       | 024733    | CLOSED CIRCUIT TELEVISION (FIXED) CAMERA UNIT                               | EA              | 57                 |
| 28       | 024734    | CLOSED CIRCUIT TELEVISION (PAN/TILT/ZOOM) CAMERA UNIT                       | EA              | 2                  |
| 29       | 024735    | TRAFFIC OPERATIONS SYSTEM (LOCATION 1)                                      | LS              | LUMP SUM           |
| 30       | 024736    | TRAFFIC OPERATIONS SYSTEM (LOCATION 2)                                      | LS              | LUMP SUM           |
| 31       | 024737    | TRAFFIC OPERATIONS SYSTEM (LOCATION 3)                                      | LS              | LUMP SUM           |
| 32       | 024738    | TRAFFIC OPERATIONS SYSTEM (LOCATION 4)                                      | LS              | LUMP SUM           |
| 33       | 024739    | TRAFFIC OPERATIONS SYSTEM (LOCATION 5)                                      | LS              | LUMP SUM           |
| 34       | 024740    | TRAFFIC OPERATIONS SYSTEM (LOCATION 6)                                      | LS              | LUMP SUM           |
| 35       | 024741    | TRAFFIC OPERATIONS SYSTEM (LOCATION 7)                                      | LS              | LUMP SUM           |
| 36       | 024742    | TRAFFIC OPERATIONS SYSTEM (LOCATION 8)                                      | LS              | LUMP SUM           |
| 37       | 024743    | TRAFFIC OPERATIONS SYSTEM (LOCATION 9)                                      | LS              | LUMP SUM           |
| 38       | 024744    | TRAFFIC OPERATIONS SYSTEM (LOCATION 10)                                     | LS              | LUMP SUM           |
| 39       | 024745    | TRAFFIC OPERATIONS SYSTEM (LOCATION 11)                                     | LS              | LUMP SUM           |
| 40       | 024746    | TRAFFIC OPERATIONS SYSTEM (LOCATION 12)                                     | LS              | LUMP SUM           |

| Item No. | Item Code | Item Description                                 | Unit of Measure | Estimated Quantity |
|----------|-----------|--|-----------------|--------------------|
| 41       | 024747    | TRAFFIC OPERATIONS SYSTEM (LOCATION 13)          | LS              | LUMP SUM           |
| 42       | 024748    | TRAFFIC OPERATIONS SYSTEM (LOCATION 14)          | LS              | LUMP SUM           |
| 43       | 024749    | TRAFFIC OPERATIONS SYSTEM (LOCATION 15)          | LS              | LUMP SUM           |
| 44       | 024750    | TRAFFIC OPERATIONS SYSTEM (LOCATION 16)          | LS              | LUMP SUM           |
| 45       | 024751    | TRAFFIC OPERATIONS SYSTEM (LOCATION 17)          | LS              | LUMP SUM           |
| 46       | 024752    | TRAFFIC OPERATIONS SYSTEM (LOCATION 18)          | LS              | LUMP SUM           |
| 47       | 024753    | TRAFFIC OPERATIONS SYSTEM (LOCATION 19)          | LS              | LUMP SUM           |
| 48       | 024754    | TRAFFIC OPERATIONS SYSTEM (LOCATION 20)          | LS              | LUMP SUM           |
| 49       | 024755    | TRAFFIC OPERATIONS SYSTEM (LOCATION 21)          | LS              | LUMP SUM           |
| 50       | 024756    | FIBER OPTIC SYSTEM                               | LS              | LUMP SUM           |
| 51       | 024757    | CAMERA CONTROL UNIT                              | EA              | 2                  |
| 52       | 024758    | VIDEO ENCODER UNIT                               | EA              | 33                 |
| 53       | 024759    | INFORMATION MESSAGE SIGN ASSEMBLY                | EA              | 22                 |
| 54       | 024760    | ARTERIAL DYNAMIC MESSAGE SIGN PANEL AND ASSEMBLY | EA              | 4                  |
| 55       | 024761    | EDGE ETHERNET SWITCH                             | EA              | 37                 |
| 56       | 024762    | AGGREGATION ETHERNET SWITCH                      | EA              | 12                 |
| 57       | 024763    | SAN MATEO HUB                                    | LS              | LUMP SUM           |
| 58       | 024764    | SIGNAL INTERCONNECT NETWORK ELEMENT              | EA              | 48                 |
| 59       | 869075    | SYSTEM TESTING AND DOCUMENTATION                 | LS              | LUMP SUM           |
| 60       | 999990    | MOBILIZATION                                     | LS              | LUMP SUM           |

# **SPECIAL PROVISIONS**

## **SECTION 1. (BLANK)**

## **SECTION 2. BIDDING**

### **2-1.01 SMALL BUSINESS AND NON-SMALL BUSINESS SUBCONTRACTOR PREFERENCES**

#### **General**

The Department applies Small Business Preference or Non-Small Business Preference under Govt Code § 14835 et seq. and 2 CA Code of Regs § 1896 et seq.

Contractors, subcontractors, suppliers, and service providers who qualify as small businesses are encouraged to apply for certification as a small business by submitting their application to the Department of General Services, Office of Small Business and DVBE Services.

Contract award is based on the total bid, not the reduced bid.

#### **Small Business Preference**

The Department allows a bidder certified as a small business by the Office of Small Business and DVBE Services, Department of General Services, a preference if:

1. The bidder submitted a completed Request for Small Business Preference or Non-Small Business Preference form with its bid
2. The low bidder did not request the preference or is not certified as a small business

The bidder's signature on the Request for Small Business Preference or Non-Small Business Preference form certifies that the bidder is certified as a small business at the time and day of bid or has submitted a complete application to the Department of General Services. The complete application and any required substantiating documentation must be received by the Department of General Services by 5:00 p.m. on bid opening date.

The Department of General Services determines if a bidder was certified on bid opening date. The Department confirms the bidder's status as a small business before applying the small business preference.

The small business preference is a reduction for bid comparison in the total bid submitted by the small business contractor by the lesser of:

1. 5 percent of the verified total bid of the low bidder
2. \$50,000

If after the application of the small business preference the Department determines that a certified small business bidder is the low bidder, the Department does not consider a request for non-small business preference.

#### **Non-Small Business Subcontractor Preference**

The Department allows a bidder not certified as a small business by the Office of Small Business and DVBE Services, Department of General Services, a preference if:

1. The bidder submitted a completed Request for Small Business Preference or Non-Small Business Preference form with its bid.
2. The Certified Small Business Listing for the Non-Small Business Preference form shows that you are subcontracting at least 25 percent to certified small businesses. You may submit this information with your bid. If you do not, submit it so that it is received by the Office Engineer no later than 4:00 p.m. on the 2nd business day after bid opening.

Each listed subcontractor and supplier must be certified as a small business at the time and day of bid or must have submitted a complete application to the Department of General Services. The complete application and any required substantiating documentation must be received by the Department of General Services by 5:00 p.m. on bid opening date.



The non-small business subcontractor preference is a reduction for bid comparison in the total bid submitted by the non-small business contractor requesting the preference by the lesser of:

1. 5 percent of the verified total bid of the low bidder
2. \$50,000

## **2-1.02 DISABLED VETERAN BUSINESS ENTERPRISES**

### **General**

Take necessary and reasonable steps to ensure that DVBEs have opportunity to participate in the contract.

Comply with Mil & Vet Code § 999 et seq.

The Department encourages bidders to obtain DVBE participation in order to ensure the Department achieves its State-mandated overall DVBE goal.

If you obtain DVBE participation:

1. Complete and submit the Certified DVBE Summary form. List all DVBE participation on this form.
2. List each 1st tier DVBE subcontractor on the Subcontractor List form regardless of percentage of the total bid.

### **DVBE Incentive**

The Department grants a DVBE incentive to each bidder who achieves a DVBE participation of 1 percent or greater (Mil & Vet Code 999.5 and Code of Regs § 1896.98 et seq).

To receive this incentive, submit the Certified DVBE Summary form. If you do not submit this form with your bid and you are the low bidder or the 2nd or 3rd low bidder, submit it so that it is received by the Office Engineer no later than 4:00 p.m. on the 4th business day after bid opening. If a DVBE joint venture is used, submit the joint venture agreement with the Certified DVBE Summary form. Other bidders may be required to submit this form if bid ranking changes.

### **Incentive Evaluation**

The Department applies the Small Business and Non-Small Business preference during bid verification and proceeds with the following evaluation for DVBE incentive.

The DVBE incentive is a reduction, for bid comparison only, in the total bid submitted by the lesser of:

1. Percentage of DVBE achievement, rounded to 2 decimal places, of the verified total bid of the low bidder
2. 5 percent of the verified total bid of the low bidder
3. \$250,000

The Department applies DVBE incentive and determines if bid ranking changes.

A non-small business bidder cannot displace a small business bidder. However, a small business bidder with higher DVBE achievement can displace another small business bidder.

The Department proceeds with awarding the contract to the new low bidder and posts the new verified bid results at its Office Engineer Web site.

## **2-1.03 CALIFORNIA COMPANIES**

Under Pub Cont Code § 6107, the Department gives preference to a "California company," as defined, for bid comparison purposes over a nonresident contractor from any state that gives or requires a preference to be given to contractors from that state on its public entity construction contracts.

Complete a California Company Preference form.

The California company reciprocal preference amount is equal to the preference amount applied by the state of the nonresident contractor with the lowest responsive bid unless the California company is eligible for a small business preference or a non-small business subcontractor preference; in which case the preference amount is the greater of the two, but not both.

If the low bidder is not a California company and a California company's bid with reciprocal preference is equal to or less than the lowest bid, the Department awards the contract to the California company on the basis of its total bid.

#### **2-1.04 TIE BID RESOLUTION**

If a small business bidder and a non-small business bidder request preferences and the reductions result in a tied bid, the Department awards the contract to the small business bidder.

If a DVBE small business bidder and a non-DVBE small business bidder request preferences and the reduction results in a tied bid, the Department awards the contract to the DVBE small business bidder.

After bid verification, if there is a tie between 2 or more bidders, the Department breaks the tie by tossing a coin.

#### **2-1.05 OPT OUT OF PAYMENT ADJUSTMENTS FOR PRICE INDEX FLUCTUATIONS**

You may opt out of the payment adjustments for price index fluctuations as specified in "Payment Adjustments for Price Index Fluctuations" of these special provisions. If you elect to opt out of the provisions of this specification, you must complete the "Opt Out of Payment Adjustments for Price Index Fluctuations" form. The completed form must be submitted with your bid.

### **SECTION 3. CONTRACT AWARD AND EXECUTION**

#### **3-1.01 SMALL BUSINESS PARTICIPATION REPORT**

The Department has established an overall 25 percent small business participation goal. To determine if the goal is achieved, the Department is tracking small business participation on all contracts.

Complete and sign the Small Business (SB) Participation Report form included in the contract documents even if no small business participation is reported. Submit it with the executed contract.

### **SECTION 4. BEGINNING OF WORK, TIME OF COMPLETION, AND LIQUIDATED DAMAGES**

The 1st working day is the earlier of (1) the 55th day after contract approval or (2) the day you start work other than the measurement of controlling field dimensions or the location of utilities.

Do not start work at the job site until the Engineer approves your submittal for:

1. Baseline Progress Schedule (Critical Path Method)
2. Water Pollution Control Program (WPCP)
3. Notification of Dispute Resolution Advisor (DRA) or Dispute Review Board (DRB) nominee and disclosure statement as specified in Section 5-1.15, "Dispute Resolution," of the Standard Specifications

You may enter the job site only to measure controlling field dimensions and locating utilities. Do not start other work activities until all the submittals from the above list are approved and the following information is submitted:

1. Notice of Materials To Be Used.
2. Contingency plan for reopening closures to public traffic.
3. Written statement from the vendor that the order for electrical material has been received and accepted by the vendor. The statement must show the dates that the materials will be shipped.
4. Written statement from the vendor that the order for structural steel for sign structures has been received and accepted by the vendor. The statement must show the dates that the materials will be shipped.

You may start work at the job site before the 55th day after contract approval if:

1. You obtain required approval for each submittal before the 55th day
2. The Engineer authorizes it in writing

The Department grants a time extension if a delay is beyond your control and prevents you from starting work at the job site on the 1st working day.

Complete the work within 200 working days.

It is anticipated that water will be available in sufficient quantities for the prosecution of the work. However, water shortages may occur during the life of the contract. Arrangements or commitments obtained by the Department are not a part of the contract. It is expressly understood and agreed that the Department assumes no responsibility to the bidder or Contractor whatsoever in respect to the arrangements made with the source. The Contractor shall assume all risks in connection with the use of the source and the terms upon which the use shall be made. There is no warranty or guaranty, either expressed or implied, to the quantity of water that can be obtained from the source. If the Department has compiled "Materials Information", as referred to in "Watering" of these special provisions, the bidder or Contractor is cautioned to make independent investigations and obtain the

commitments or allocations as the bidder or Contractor deems necessary to verify the quantity of water available. The Contractor shall make arrangements or obtain commitments or allocations necessary to provide water for the project.

During the progress of the work, if water becomes unavailable or unavailable in the quantities needed for prosecution of the work, the unavailability of water will be considered a material shortage. The provisions in Section 5-1.116, "Differing Site Conditions (23 CFR 635.109)," of the Standard Specifications shall not apply to the unavailability of water.

## **SECTION 5. GENERAL**

### **5-1.01 EMISSIONS REDUCTION**

Contract execution constitutes submittal of the following certification:

I am aware of the emissions reduction regulations being mandated by the California Air Resources Board. I will comply with such regulations before commencing the performance of the work and maintain compliance throughout the duration of this contract.

### **5-1.02 NON-SMALL BUSINESSES**

Use each subcontractor as shown on the Certified Small Business Listing for the Non-Small Business Preference form unless you receive authorization for a substitution.

The requirement that small businesses be certified by the bid opening date does not apply to small business substitutions after contract award.

Maintain records of subcontracts made with certified small business subcontractors and records of materials purchased from certified small business suppliers. Include in the records:

1. Name and business address of each business
2. Total amount paid to each business

For the purpose of determining compliance with 2 CA Code of Regs § 1896 et seq.:

1. Provide the Department relevant information requested.
2. Upon reasonable notice and during normal business hours, permit access to its premises for the purpose of:
  - 2.1. Interviewing employees
  - 2.2. Inspecting and copying books, records, accounts and other material that may be relevant to a matter under investigation

### **5-1.03 DISABLED VETERAN BUSINESS ENTERPRISES**

Use each DVBE as shown on the Certified DVBE Summary form unless you receive authorization for a substitution.

The requirement that DVBEs be certified by the bid opening date does not apply to DVBE substitutions after contract award.

Maintain records of subcontracts made with certified DVBEs. Include in the records:

1. Name and business address of each business
2. Total amount paid to each business

For the purpose of determining compliance with Pub Cont Code § 10115 et seq.:

1. Upon contract completion, complete and submit Final Report - Utilization of Disabled Veteran Business Enterprises (DVBE) State Funded Projects Only form
2. Upon reasonable notice and during normal business hours, permit access to its premises for the purpose of:
  - 2.1. Interviewing employees
  - 2.2. Inspecting and copying books, records, accounts and other material that may be relevant to a matter under investigation

## **5-1.04 PAYMENT ADJUSTMENTS FOR PRICE INDEX FLUCTUATIONS**

### **GENERAL**

#### **Summary**

This section applies to asphalt contained in materials for pavement structural sections and pavement surface treatments such as hot mix asphalt (HMA), tack coat, asphaltic emulsions, bituminous seals, asphalt binders, and modified asphalt binders placed in the work. This section does not apply if you opted out of payment adjustment for price index fluctuations at the time of bid.

The Engineer adjusts payment if the California Statewide Crude Oil Price Index for the month the material is placed is more than 5 percent higher or lower than the price index at the time of bid.

The California Statewide Crude Oil Price Index is determined each month on or about the 1st business day of the month by the Department using the average of the posted prices in effect for the previous month as posted by Chevron, ExxonMobil, and ConocoPhillips for the Buena Vista, Huntington Beach, and Midway Sunset fields.

If a company discontinues posting its prices for a field, the Department determines the index from the remaining posted prices. The Department may include additional fields to determine the index.

For the California Statewide Crude Oil Price Index, go to:

<http://www.dot.ca.gov/hq/construc/crudeoilindex/>

If the adjustment is a decrease in payment, the Department deducts the amount from the monthly progress payment.

The Department includes payment adjustments for price index fluctuations when making adjustments under Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications.

If you do not complete the work within the contract time, payment adjustments during the overrun period are determined using the California Statewide Crude Oil Price Index in effect for the month in which the overrun period began.

If the price index at the time of placement increases:

1. 50 percent or more over the price index at bid opening, notify the Engineer.
2. 100 percent or more over the price index at bid opening, do not furnish material containing asphalt until the Engineer authorizes you to proceed with that work. The Department may decrease Bid item quantities, eliminate Bid items, or terminate the contract.

#### **Submittals**

Before placing material containing asphalt, submit the current sales and use tax rate in effect in the tax jurisdiction where the material is to be placed.

Submit certified weight slips for HMA, tack coat, asphaltic emulsions, and modified asphalt binders, including those materials not paid for by weight, as specified in Section 9-1.01, "Measurement of Quantities," of the Standard Specifications. For slurry seals, submit certified weight slips separately for the asphaltic emulsion.

## **ASPHALT QUANTITIES**

### **General**

Interpret the term "ton" as "tonne" for projects using metric units.

#### **Hot Mix Asphalt**

The Engineer calculates the quantity of asphalt in HMA using the following formula:

$$Q_h = HMATT \times [X_a / (100 + X_a)]$$

where:

Q<sub>h</sub> = quantity in tons of asphalt used in HMA  
HMATT = HMA total tons placed  
X<sub>a</sub> = theoretical asphalt content from job mix formula expressed as percentage of the weight of dry aggregate

### **Rubberized Hot Mix Asphalt**

The Engineer calculates the quantity of asphalt in rubberized HMA (RHMA) using the following formula:

$$Q_{rh} = RHMATT \times 0.80 \times [X_{arb} / (100 + X_{arb})]$$

where:

$Q_{rh}$  = quantity in tons of asphalt in asphalt rubber binder used in RHMA  
 $RHMATT$  = RHMA total tons placed  
 $X_{arb}$  = theoretical asphalt rubber binder content from the job mix formula expressed as percentage of the weight of dry aggregate

### **Modified Asphalt Binder in Hot Mix Asphalt**

The Engineer calculates the quantity of asphalt in modified asphalt binder using the following formula:

$$Q_{mh} = MHMATT \times [(100 - X_{am}) / 100] \times [X_{mab} / (100 + X_{mab})]$$

where:

$Q_{mh}$  = quantity in tons of asphalt in modified asphalt binder used in HMA  
 $MHMATT$  = modified asphalt binder HMA total tons placed  
 $X_{am}$  = specified percentage of asphalt modifier  
 $X_{mab}$  = theoretical modified asphalt binder content from the job mix formula expressed as percentage of the weight of dry aggregate

### **Hot Mix Asphalt Containing Reclaimed Asphalt Pavement (RAP)**

The Engineer calculates the quantity of asphalt in HMA containing RAP using the following formulas:

$$Q_{rap} = HMATT \times [X_{aa} / (100 + X_{aa})]$$

where:

$$X_{aa} = X_{ta} - [(100 - X_{new}) \times (X_{ra} / 100)]$$

and

$Q_{rap}$  = quantity in tons of asphalt used in HMA containing RAP  
 $HMATT$  = HMA total tons placed  
 $X_{aa}$  = asphalt content of HMA adjusted to account for the asphalt content in RAP expressed as percentage of the weight of dry aggregate  
 $X_{ta}$  = total asphalt content of HMA expressed as percentage of the weight of dry aggregate  
 $X_{new}$  = theoretical percentage of new aggregate in the HMA containing RAP determined from RAP percentage in the job mix formula  
 $X_{ra}$  = asphalt content of RAP expressed as percentage

### **Tack Coat**

The Engineer calculates the quantity of asphalt in tack coat ( $Q_{tc}$ ) as either:

1. Asphalt binder using the asphalt binder total tons placed as tack coat
2. Asphaltic emulsion by applying the formula in "Asphaltic Emulsion" to the asphaltic emulsion total tons placed as tack coat

### **Asphaltic Emulsion**

The Engineer calculates the quantity of asphalt in asphaltic emulsions, including fog seals and tack coat, using the following formula:

$$Q_e = AETT \times (X_e / 100)$$

where:

- Q<sub>e</sub> = quantity in tons of asphalt used in asphaltic emulsions
- AETT = undiluted asphaltic emulsions total tons placed
- X<sub>e</sub> = minimum percent residue specified in Section 94, "Asphaltic Emulsions," of the Standard Specifications based on the type of emulsion used

You may, as an option, determine "X<sub>e</sub>" by submitting actual daily test results for asphalt residue for the asphaltic emulsion used. If you choose this option, you must:

1. Take 1 sample every 200 tons but not less than 1 sample per day in the presence of the Engineer from the delivery truck, at midload from a sampling tap or thief, and in the following order:
  - 1.1. Draw and discard the 1st gallon
  - 1.2. Take two separate 1/2-gallon samples
2. Submit 1st sample at the time of sampling
3. Provide 2nd sample within 3 business days of sampling to an independent testing laboratory that participates in the AASHTO Proficiency Sample Program
4. Submit test results from independent testing laboratory within 10 business days of sample date

### **Slurry Seal**

The Engineer calculates the quantity of asphalt in slurry seals (Q<sub>ss</sub>) by applying the formula in "Asphaltic Emulsion" to the actual quantity of asphaltic emulsion used in producing the slurry seal mix.

### **Modified Asphalt Binder**

The Engineer calculates the quantity of asphalt in modified asphalt binder using the following formula:

$$Q_{mab} = MABTT \times [(100 - X_{am}) / 100]$$

where:

- Q<sub>mab</sub> = quantity in tons of asphalt used in modified asphalt binder
- MABTT = modified asphalt binder total tons placed
- X<sub>am</sub> = specified percentage of asphalt modifier

### **Other Materials**

For other materials containing asphalt not covered above, the Engineer determines the quantity of asphalt (Q<sub>o</sub>).

### **PAYMENT ADJUSTMENTS**

The Engineer includes payment adjustments for price index fluctuations in progress pay estimates. If material containing asphalt is placed within 2 months during 1 estimate period, the Engineer calculates 2 separate adjustments. Each adjustment is calculated using the price index for the month in which the quantity of material containing asphalt subject to adjustment is placed in the work. The sum of the 2 adjustments is used for increasing or decreasing payment in the progress pay estimate.

The Engineer calculates each payment adjustment as follows:

$$PA = Qt \times A$$

where:

PA = Payment adjustment in dollars for asphalt contained in materials placed in the work for a given month.

Qt = Sum of quantities of asphalt (Qh + Qrh + Qmh + Qrap + Qtc + Qe + Qss + Qmab + Qo).

A = Adjustment in dollars per ton of asphalt used to produce materials placed in the work rounded to the nearest \$0.01.

For US Customary projects, use:

$A = [(Iu / Ib) - 1.05] \times Ib \times [1 + (T / 100)]$  for an increase in the crude oil price index exceeding 5 percent

$A = [(Iu / Ib) - 0.95] \times Ib \times [1 + (T / 100)]$  for a decrease in the crude oil price index exceeding 5 percent

For metric projects, use:

$A = 1.1023 \times [(Iu / Ib) - 1.05] \times Ib \times [1 + (T / 100)]$  for an increase in the crude oil price index exceeding 5 percent

$A = 1.1023 \times [(Iu / Ib) - 0.95] \times Ib \times [1 + (T / 100)]$  for a decrease in the crude oil price index exceeding 5 percent

Iu = California Statewide Crude Oil Price Index for the month in which the quantity of asphalt subject to adjustment was placed in the work.

Ib = California Statewide Crude Oil Price Index for the month in which the bid opening for the project occurred

T = Sales and use tax rate, expressed as a percent, currently in effect in the tax jurisdiction where the material is placed. If the tax rate information is not submitted timely, the statewide sales and use tax rate is used in the payment adjustment calculations until the tax rate information is submitted.

#### **5-1.05 SURFACE MINING AND RECLAMATION ACT**

Imported borrow or aggregate material must come from a surface mine permitted under the Surface Mining and Reclamation Act of 1975 (SMARA), Pub Res Code § 2710, et seq., or from an exempt site.

The Department of Conservation, Office of Mine Reclamation maintains a list of permitted mine sites. For the list of permitted sites, go to:

[http://www.conservation.ca.gov/omr/ab\\_3098\\_list](http://www.conservation.ca.gov/omr/ab_3098_list)

If you import borrow or aggregate material from a surface mine not on this list, submit proof the mine is exempt from SMARA.

### 5-1.06 ELECTRONIC SUBMISSION OF PAYROLL RECORDS

In lieu of submitting weekly payroll records to the Engineer as specified in Section 7-1.01A(3), "Payroll Records," of the Standard Specifications, you may submit weekly payroll records electronically.

Before submitting payroll records electronically, you must complete and sign the Contractor's Acknowledgement and submit it to the District where your project is located. Submit your signed acknowledgement to the corresponding District electronic mailbox shown in the following table:

| Electronic Mailboxes |                                |
|----------------------|--------------------------------|
| District             | Address                        |
| 1                    | district1.payrolls@dot.ca.gov  |
| 2                    | district2.payrolls@dot.ca.gov  |
| 3                    | district3.payrolls@dot.ca.gov  |
| 4                    | district4.payrolls@dot.ca.gov  |
| 5                    | district5.payrolls@dot.ca.gov  |
| 6                    | district6.payrolls@dot.ca.gov  |
| 7                    | district7.payrolls@dot.ca.gov  |
| 8                    | district8.payrolls@dot.ca.gov  |
| 9                    | district9.payrolls@dot.ca.gov  |
| 10                   | district10.payrolls@dot.ca.gov |
| 11                   | district11.payrolls@dot.ca.gov |
| 12                   | district12.payrolls@dot.ca.gov |

The Department responds with an e-mail containing a Caltrans Internet Certificate to be used for the electronic submission of payroll records. You must agree to accept this certificate and reply to the e-mail. After you accept the certificate and reply to the e-mail, the Department is ready to accept your electronic submissions.

Each electronic submission must:

1. Include payroll records in a nonmodifiable PDF image format. No spreadsheets, word documents, or password protected documents are accepted.
2. Include payroll records with all data elements required by the Labor Code § 1776.
3. Include a signed Statement of Compliance form with each weekly record.
4. Be received by the Department by close of business on the 15th day of the month for the prior month's work.
5. Be encrypted before submission.
6. Contain the following information in the subject line:
  - 6.1. Contract number
  - 6.2. Week ending date as W/E mm/dd/yy
7. Contain 1 contract number and week ending date per submission.

For additional information on electronic submission of payroll records, go to:

<http://www.dot.ca.gov/hq/construc/LaborCompliance/index.htm>

### 5-1.07 FORCE ACCOUNT PAYMENT

Payment for extra work at force account will be determined by either non-subcontracted or subcontracted force account payment unless otherwise specified.



### **Non-Subcontracted Force Account Payment**

When extra work to be paid for on a force account basis is performed by the Contractor, compensation will be determined as specified in Section 9-1.03, "Force Account Payment," of the Standard Specifications except for the markups. The markups specified in Section 9-1.03B, "Labor," Section 9-1.03C, "Materials," and Section 9-1.03D, "Equipment Rental" are changed to the following markups:

| Cost             | Percent Markup |
|------------------|----------------|
| Labor            | 30             |
| Materials        | 10             |
| Equipment Rental | 10             |

The above markups shall be applied to work performed on a force account basis, regardless of whether the work revises the current contract completion date.

The above markups, together with payments made for time-related overhead under "Time-Related Overhead" of these special provisions, shall constitute full compensation for all overhead costs for work performed on a force account basis.

Full compensation for overhead costs for work performed on a force account basis, and for which no adjustment is made to the quantity for time-related overhead conforming to the provisions in "Time-Related Overhead" of these special provisions, shall be considered as included in the markups specified above, and no additional compensation will be allowed therefor.

### **Subcontracted Force Account Payment**

When extra work to be paid for on a force account basis is performed by a subcontractor approved in conformance with the provisions in Section 5-1.055, "Subcontracting," of the Standard Specifications, compensation will be determined in accordance with the provisions in Section 9-1.03, "Force Account Payment," of the Standard Specifications.

## **5-1.08 RESPONSIBILITY TO OTHER ENTITIES**

The Contractor shall be responsible for any liability imposed by law and for injuries to or death of any person including, but not limited to, workers and the public or damage to property, and shall indemnify and save harmless any county, city or district, its officers and employees connected with the work, within the limits of which county, city or district the work is being performed, all in the same manner and to the same extent conforming to the provisions in Section 7-1.12, "Indemnification and Insurance," of the Standard Specifications, for the protection of the State of California and all officers and employees thereof connected with the work.

## **5-1.09 AREAS FOR CONTRACTOR'S USE**

Attention is directed to the provisions in Section 7-1.19, "Rights in Land and Improvements," of the Standard Specifications and these special provisions.

The highway right of way shall be used only for purposes that are necessary to perform the required work. The Contractor shall not occupy the right of way, or allow others to occupy the right of way, for purposes which are not necessary to perform the required work.

No State-owned parcels adjacent to the right of way are available for the exclusive use of the Contractor within the contract limits. The Contractor shall secure, at the Contractor's own expense, areas required for plant sites, storage of equipment or materials, or for other purposes.

No area is available within the contract limits for the exclusive use of the Contractor. However, temporary storage of equipment and materials on State property may be arranged with the Engineer, subject to the prior demands of State maintenance forces and to other contract requirements. Use of the Contractor's work areas and other State-owned property shall be at the Contractor's own risk, and the State shall not be held liable for damage to or loss of materials or equipment located within such areas.

## **5-1.10 PAYMENTS**

In determining the partial payments to be made to the Contractor, only the following listed materials will be considered for inclusion in the payment as materials furnished but not incorporated in the work:

- A. Splice Vaults
- B. Fiber Optic Cable
- C. Innerduct
- D. Fiber Optic Conduit

### 5-1.11 SUPPLEMENTAL PROJECT INFORMATION

The Department makes the following supplemental project information available:

#### Supplemental Project Information

| Means   | Description  |
|---|--|
| Included in the Information Handout                   | Geotechnical Design and Foundation Plan Review Memo for the San Mateo County Smart Corridor Project dated October 31, 2012 |
| Available as specified in the Standard Specifications | Cross sections<br>Bridge as-built drawings   |

### 5-1.12 NOISE CONTROL

#### General

This section applies to equipment on the project or associated with the project, including trucks, transit mixers, stationary equipment, and transient equipment.

Do not exceed 86 dBA LMax at 50 feet from the job site activities from 7 p.m. to 7 a.m. except you may perform the following activities during the hours and for the days shown in the following table:

#### Noise Restriction Exceptions

| Activity   | Hours  |        | Days   |          |
|--|--------|--------|--------|----------|
|  | From   | To     | From   | Through  |
| Cold Plane AC Pavement work                                    | 7 p.m. | 7 a.m. | Sunday | Saturday |
| CIDH piling work   | 7 p.m. | 7 a.m. | Sunday | Saturday |
| Fiber Optic trench sawcutting, excavation and backfilling work | 7 p.m. | 7 a.m. | Sunday | Saturday |
| Loop Detector sawcutting work                                  | 7 p.m. | 7 a.m. | Sunday | Saturday |

#### Noise Monitoring

Provide 1 Type 1 sound level meter and 1 acoustic calibrator to be used by the Department until contract acceptance. Provide training by a person trained in noise monitoring to 1 Department employee designated by the Engineer. The sound level meter must be calibrated and certified by the manufacturer or other independent acoustical laboratory before delivery to the Department. Provide annual recalibration by the manufacturer or other independent acoustical laboratory. The sound level meter must be capable of taking measurements using the A-weighting network and the slow response settings. The measurement microphone must be fitted with a windscreen. The Department returns the equipment to you at contract acceptance.

The contract lump sum price paid for noise monitoring includes full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all work involved in noise monitoring.

### 5-1.13 PROJECT APPEARANCE

The Contractor shall maintain a neat appearance to the work.

In areas visible to the public, the following shall apply:

- A. When practicable, broken concrete and debris developed during clearing and grubbing shall be disposed of concurrently with its removal. If stockpiling is necessary, the material shall be removed or disposed of weekly.
- B. Trash bins shall be furnished for debris from structure construction. Debris shall be placed in trash bins daily. Forms or falsework that are to be re-used shall be stacked neatly concurrently with their removal. Forms and falsework that are not to be re-used shall be disposed of concurrently with their removal.

Full compensation for conforming to the provisions in this section, not otherwise provided for, shall be considered as included in prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

### 5-1.14 RELATIONS WITH CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

This project lies within the boundaries of the San Francisco Bay Regional Water Quality Control Board (RWQCB).

The State Water Resources Control Board (SWRCB) has issued to the Department a permit that governs storm water and non-storm water discharges from the Department's properties, facilities, and activities. The Department's permit is entitled "Order No. 99 - 06 - DWQ, NPDES No. CAS000003, National Pollutant Discharge Elimination System (NPDES) Permit, Statewide Storm Water Permit and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans)." Copies of the Department's permit are available for review from the SWRCB, Division of Water Quality, 1001 "I" Street, P.O. Box 100, Sacramento, California 95812-0100, Telephone fax: (916) 341-5463 and may also be obtained at:

[http://www.waterboards.ca.gov/water\\_issues/programs/stormwater/caltrans.shtml](http://www.waterboards.ca.gov/water_issues/programs/stormwater/caltrans.shtml)

The Contractor shall know and comply with provisions of Federal, State, and local regulations and requirements that govern the Contractor's operations and storm water and non-storm water discharges from the project site and areas of disturbance outside the project limits during construction. Attention is directed to Sections 7-1.01, "Laws to be Observed," 5-1.18, "Property and Facility Preservation," 7-1.12, "Indemnification and Insurance," and 9-1.07E(5), "Penalty Withholds," of the Standard Specifications.

The Contractor shall notify the Engineer immediately upon request from the regulatory agencies to enter, inspect, sample, monitor, or otherwise access the project site or the Contractor's records pertaining to water pollution control work. The Contractor and the Department shall provide copies of correspondence, notices of violation, enforcement actions, or proposed fines by regulatory agencies to the requesting regulatory agency.

#### **5-1.15 NONHIGHWAY FACILITIES (INCLUDING UTILITIES)**

Utility location information is incomplete. Make arrangements with the utility owner(s) to coordinate utility location activities.

### **SECTION 6. (BLANK)**

### **SECTION 7. (BLANK)**

### **SECTION 8. MATERIALS**

#### **SECTION 8-1. MISCELLANEOUS**

##### **8-1.01 PREQUALIFIED AND TESTED SIGNING AND DELINEATION MATERIALS**

The Department maintains the following list of Prequalified and Tested Signing and Delineation Materials. The Engineer shall not be precluded from sampling and testing products on the list of Prequalified and Tested Signing and Delineation Materials.

The manufacturer of products on the list of Prequalified and Tested Signing and Delineation Materials shall furnish the Engineer a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each type of traffic product supplied.

For those categories of materials included on the list of Prequalified and Tested Signing and Delineation Materials, only those products shown within the listing may be used in the work. Other categories of products, not included on the list of Prequalified and Tested Signing and Delineation Materials, may be used in the work provided they conform to the requirements of the Standard Specifications.

Materials and products may be added to the list of Prequalified and Tested Signing and Delineation Materials if the manufacturer submits a New Product Information Form to the New Product Coordinator at the Transportation Laboratory. Upon a Departmental request for samples, sufficient samples shall be submitted to permit performance of required tests. Approval of materials or products will depend upon compliance with the specifications and tests the Department may elect to perform.

#### **PAVEMENT MARKERS, PERMANENT TYPE**

##### **Retroreflective With Abrasion Resistant Surface (ARS)**

("length along the direction of travel" x "marker width")

1. Apex, Model 921AR (4" x 4")
2. Ennis-Flint, Models C88 (4" x 4"), 911 (4" x 4") and C80FH (3.1" x 4.5")
3. Ray-O-Lite, Models "AA" ARC II (4" x 4") and ARC Round Shoulder (4" x 4")
4. 3M Series 290 (3.5" x 4")
5. 3M Series 290 PSA

6. Glowlite, Inc Model 988AR (4" x 4")

**Retroreflective With Abrasion Resistant Surface (ARS)**

(for recessed applications only)

1. Ennis-Flint, Model 948 (2.3" x 4.7")
  2. Ennis-Flint, Model 944SB (2" x 4")\*
  3. Ray-O-Lite, Model 2002 (2" x 4.6")
  4. Ray-O-Lite, Model 2004 (2" x 4")\*
- \*For use only in 4.5 inch wide (older) recessed slots

**Non-Reflective, 4-inch Round**

1. Apex Universal (Ceramic)
2. Apex Universal, Models 929 (ABS) and 929PP (Polypropylene)
3. Glowlite, Inc. (Ceramic) and PP (Polypropylene)
4. Hi-Way Safety, Inc., Models P20-2000W and 2001Y (ABS)
5. Interstate Sales, "Diamond Back" (Polypropylene)
6. Novabrite Models Cdot (White) Cdot-y (Yellow), Ceramic
7. Novabrite Models Pdot-w (White) Pdot-y (Yellow), Polypropylene
8. Three D Traffic Works TD10000 (ABS), TD10500 (Polypropylene)
9. Ray-O-Lite, Ray-O-Dot (Polypropylene)

**PAVEMENT MARKERS, TEMPORARY TYPE**

**Temporary Markers For Long Term Day/Night Use (180 days or less)**

1. Vega Molded Products "Temporary Road Marker" (3" x 4")
2. Pexco LLC, Halftrack model 25, 26 and 35

**Temporary Markers For Short Term Day/Night Use (14 days or less)**

(For seal coat or chip seal applications, clear protective covers are required)

1. Apex Universal, Model 932
2. Pexco LLC, Models T.O.M., T.R.P.M., and "HH" (High Heat)
3. Hi-Way Safety, Inc., Model 1280/1281
4. Glowlite, Inc., Model 932

**STRIPING AND PAVEMENT MARKING MATERIAL**

**Permanent Traffic Striping and Pavement Marking Tape**

1. Advanced Traffic Marking, Series 300 and 400
2. Brite-Line, Series 1000
3. Brite-Line, "DeltaLine XRP"
4. Swarco Industries, "Director 35" (For transverse application only)
5. Swarco Industries, "Director 60"
6. 3M, "Stamark" Series 380 and 270 ES
7. 3M, "Stamark" Series 420 (For transverse application only)

**Temporary (Removable) Striping and Pavement Marking Tape (180 days or less)**

1. Advanced Traffic Marking, Series 200
2. Brite-Line, "Series 100", "Deltaline TWR"
3. Garlock Rubber Technologies, Series 2000
4. Tape 4, Aztec, Grade 102
5. Swarco Industries, "Director-2", "Director 2-Wet Reflective"
6. Trelleborg Industries, R140 Series
7. 3M Series 620 "CR", Series 780 and Series 710
8. 3M Series A145, Removable Black Line Mask  
(Black Tape: for use only on Hot mix asphalt surfaces)
9. Advanced Traffic Marking Black "Hide-A-Line"  
(Black Tape: for use only on Hot mix asphalt surfaces)
10. Brite-Line "BTR" Black Removable Tape  
(Black Tape: for use only on Hot mix asphalt surfaces)

11. Trelleborg Industries, RB-140  
(Black Tape: for use only on Hot mix asphalt surfaces)

**Preformed Thermoplastic (Heated in place)**

1. Ennis-Flint, "Hot Tape"
2. Ennis-Flint, "Premark Plus"
3. Ennis-Flint, "Flametape"

**Ceramic Surfacing Laminate, 6" x 6"**

1. Highway Ceramics, Inc.

**CLASS 1 DELINEATORS**

**One Piece Driveable Flexible Type, 66-inch**

1. Pexco LLC, "Flexi-Guide Models 400 and 566"
2. Carsonite, Curve-Flex CFRM-400
3. Carsonite, Roadmarker CRM-375
4. FlexStake, Model 654 TM
5. GreenLine Model CGD1-66

**Special Use Type, 66-inch**

1. Pexco LLC, Model FG 560 (with 18-inch U-Channel base)
2. Carsonite, "Survivor" (with 18-inch U-Channel base)
3. Carsonite, Roadmarker CRM-375 (with 18-inch U-Channel base)
4. FlexStake, Model 604
5. GreenLine Model CGD (with 18-inch U-Channel base)
6. Impact Recovery Model D36, with #105 Driveable Base
7. Safe-Hit with 8-inch pavement anchor (SH248-GP1)
8. Safe-Hit with 15-inch soil anchor (SH248-GP2) and with 18-inch soil anchor (SH248-GP3)
9. Safe-Hit RT 360 Post with Soil Mount Anchor (GPS)
10. Shur-Tite Products, Shur-Flex Drivable

**Surface Mount Type, 48-inch**

1. Bent Manufacturing Company, Masterflex Model MFEX 180-48
2. Carsonite, "Channelizer"
3. FlexStake, Models 704, 754 TM, and EB4
4. Impact Recovery Model D48, with #101 Fixed (Surface-Mount) Base
5. Three D Traffic Works "Channelflex" ID No. 522248W
6. Flexible Marker Support, Flexistiff Model C-9484
7. Safe-Hit, SH 248 SMR

**CHANNELIZERS**

**Surface Mount Type, 36-inch**

1. Bent Manufacturing Company, Masterflex Models MF-360-36 (Round) MF-180-36 (Flat) and MFEX 180—36
2. Pexco LLC, Flexi-Guide Models FG300PE, FG300UR, and FG300EFX
3. Carsonite, "Super Duck" (Round SDR-336)
4. Carsonite, Model SDCF03601MB "Channelizer"
5. FlexStake, Models 703, 753 TM, and EB3
6. GreenLine, Model SMD-36
7. Hi-way Safety, Inc. "Channel Guide Channelizer" Model CGC36
8. Impact Recovery Model D36, with #101 Fixed (Surface-Mount) Base
9. Safe-Hit, Guide Post, Model SH236SMA and Dura-Post, Model SHL36SMA
10. Three D Traffic Works "Boomerang" 5200 Series
11. Flexible Marker Support, Flexistiff Model C-9484-36
12. Shur-Tite Products, Shur-Flex

### **Lane Separation System**

1. Pexco LLC, "Flexi-Guide (FG) 300 Curb System"
2. Qwick Kurb, "Klemmfix Guide System"
3. Dura-Curb System
4. Tuff Curb
5. FG 300 Turnpike Curb
6. Shur-Tite Products, SHUR-Curb , Model No. SF0200

### **CONICAL DELINEATORS, 42-inch**

(For 28-inch Traffic Cones, see Standard Specifications)

1. Bent Manufacturing Company "T-Top", TDSC Series
2. Plastic Safety Systems "Navigator-42"
3. Traffix Devices "Grabber"
4. Three D Traffic Works "Ringtop" TD7000, ID No. 742143
5. Three D Traffic Works, TD7500
6. Work Area Protection Corp. C-42
7. Custom-Pak 4600 (Part No. 93005-0001)
8. Plasticade, Navicade, 650 RI

### **OBJECT MARKERS**

#### **Type "K", 18-inch**

1. Pexco LLC, Model FG318PE
2. Carsonite, Model SMD 615
3. FlexStake, Model 701 KM
4. Safe-Hit, Model SH718SMA
5. Impact Recover Systems, Model 282-K

#### **Type "Q" Object Markers, 24-inch**

1. Bent Manufacturing "Masterflex" Model MF-360-24
2. Pexco LLC, Model FG324PE
3. Carsonite, "Channelizer"
4. FlexStake, Model 701KM
5. Safe-Hit, Models SH824SMA\_WA and SH824GP3\_WA
6. Three D Traffic Works ID No. 531702W and TD 5200
7. Three D Traffic Works ID No. 520896W
8. Safe-Hit, Dura-Post SHLQ-24"
9. Flexible Marker Support, IMC 9484-24
10. Impact Recover Systems, Model 282-Q

### **CONCRETE BARRIER MARKERS AND TEMPORARY RAILING (TYPE K) REFLECTORS**

#### **Impactable Type**

1. ARTUK, "FB"
2. Pexco LLC, Models PCBM-12 and PCBM-T12, PCBM 912
3. Duraflex Corp., "Flexx 2020" and "Electriflexx"
4. Hi-Way Safety, Inc., Model GMKRM100
5. Plastic Safety Systems "BAM" Models OM-BARR and OM-BWAR
6. Three D Traffic Works "Roadguide" Model TD 9300

#### **Non-Impactable Type**

1. ARTUK, JD Series
2. Plastic Safety Systems "BAM" Models OM-BITARW and OM-BITARA
3. Vega Molded Products, Models GBM and JD
4. Plastic Vacuum Forming, "Cap-It C400"

## **METAL BEAM GUARD RAIL POST MARKERS**

(For use to the left of traffic)

1. Pexco LLC, "Mini" (3" x 10"), I-Flex
2. Creative Building Products, "Dura-Bull, Model 11201"
3. Duraflex Corp., "Railrider"
4. Plastic Vacuum Forming, "Cap-It C300"

## **CONCRETE BARRIER DELINEATORS, 16-inch**

(For use to the right of traffic)

1. Pexco LLC, Model PCBM T-16
2. Safe-Hit, Model SH216RBM
3. Three D Traffic Works "Roadguide" Model 9400

## **CONCRETE BARRIER-MOUNTED MINI-DRUM (10" x 14" x 22")**

1. Stinson Equipment Company "SaddleMarker"

## **GUARD RAILING DELINEATOR**

(Place top of reflective element at 48 inches above plane of roadway)

### **Wood Post Type, 27-inch**

1. Pexco LLC, FG 427 and FG 527
2. Carsonite, Model 427
3. FlexStake, Model 102 GR
4. GreenLine GRD 27
5. Safe-Hit, Model SH227GRD
6. Three D Traffic Works "Guardflex" TD9100
7. New Directions Mfg, NDM27
8. Shur-Tite Products, Shur-Tite Flat Mount
9. Glasforms, Hiway-Flex, GR-27-00
10. Impact Recover Systems, 200-GRP

### **Barrier, Guardrail Visibility Enhancement**

1. UltraGuard Safety System, Potters Industries, Inc.
2. Worldwide Safety and Irwin Hodson, Monarch Butterfly Reflective Device (MBGR only)

### **Steel Post Type**

1. Carsonite, Model CFGR-327

## **RETROREFLECTIVE SHEETING**

### **Channelizers, Barrier Markers, and Delineators**

1. Avery Dennison T-6500 Series (For rigid substrate devices only)
2. Avery Dennison WR-7100 Series and WR-6100
3. Nippon Carbide Industries, Flexible Ultralite Grade (ULG) II
4. Reflexite, PC-1000 Metalized Polycarbonate
5. Reflexite, AC-1000 Acrylic
6. Reflexite, AP-1000 Metalized Polyester
7. Reflexite, Conformalight, AR-1000 Abrasion Resistant Coating
8. 3M, High Intensity

### **Traffic Cones, 4-inch and 6-inch Sleeves**

1. Nippon Carbide Industries, Flexible Ultralite Grade (ULG) II
2. Reflexite, Vinyl, "TR" (Semi-transparent) or "Conformalight", C85
3. 3M Series 3840, Series 3340
4. Avery Dennison S-9000C

## **Drums**

1. Avery Dennison WR-6100 Series
2. Nippon Carbide Industries, Flexible Ultralite Grade (ULG) II
3. Reflexite, "Conformalight", "Super High Intensity" or "High Impact Drum Sheeting"
4. 3M Series 3810

## **BARRICADE SHEETING**

### **Type I, Medium-Intensity (Typically Enclosed Lens, Glass-Bead Element)**

1. Nippon Carbide Industries, CN8117
2. Avery Dennison, W 1100 series
3. 3M Series CW 44

### **Type II, Medium-High-Intensity (Typically Enclosed Lens, Glass-Bead Element)**

1. Avery Dennison, W-2100 Series

### **Type IV, High Intensity (Typically Unmetalized Microprismatic Retroreflective Element)**

1. 3M Series 3334/3336

### **Vertical Clearance Signs: Structure Mounted**

1. 3M Model 4061, Diamond Grade DG3, Fluorescent Yellow

### **Signs: Type II, Medium-High-Intensity (Typically Enclosed Lens, Glass-Bead Element)**

1. Avery Dennison, T-2500 Series
2. Nippon Carbide Industries, Nikkalite 18000

### **Signs: Type III, High-Intensity (Typically Encapsulated Glass-Bead Element)**

1. Avery Dennison, T-5500A and T-6500 Series
2. Nippon Carbide Industries, Nikkalite Brand Ultralite Grade II
3. 3M 3870 and 3930 Series
4. Changzhou Hua R Sheng, Series TM 1200
5. Oracal, Oralite Series 5800

### **Signs: Type IV, High-Intensity (Typically Unmetallized Microprismatic Element)**

1. Avery Dennison, T-6500 Series
2. Nippon Carbide Industries, Crystal Grade, 94000 Series
3. Nippon Carbide Industries, Model No. 94847 Fluorescent Orange
4. 3M Series 3930 and Series 3924S

### **Signs: Type VI, Elastomeric (Roll-Up) High-Intensity, without Adhesive**

1. Avery Dennison, WU-6014
2. Novabrite LLC, "Econobrite"
3. Reflexite "Vinyl"
4. Reflexite "SuperBright"
5. Reflexite "Marathon"
6. 3M Series RS20

### **Signs: Type VIII, Super-High-Intensity (Typically Unmetallized Microprismatic Element)**

1. Avery Dennison, T-7500 Series
2. Avery Dennison, T-7511 Fluorescent Yellow
3. Avery Dennison, T-7513 Fluorescent Yellow Green
4. Avery Dennison, W-7514 Fluorescent Orange
5. Nippon Carbide Industries, Nikkalite Crystal Grade Series 92800
6. Nippon Carbide Industries, Nikkalite Crystal Grade Model 92847 Fluorescent Orange



**Signs: Type IX, Very-High-Intensity (Typically Unmetallized Microprismatic Element)**

1. 3M VIP Series 3981 Diamond Grade Fluorescent Yellow
2. 3M VIP Series 3983 Diamond Grade Fluorescent Yellow/Green
3. 3M VIP Series 3990 Diamond Grade
4. Avery Dennison T-9500 Series
5. Avery Dennison, T9513, Fluorescent Yellow Green
6. Avery Dennison, W9514, Fluorescent Orange
7. Avery Dennison, T-9511 Fluorescent Yellow

**Signs: Type XI, Very High Intensity (Typically Unmetallized Microprismatic Element)**

1. 3M Diamond Grade, DG3, Series 4000
2. 3M Diamond Grade, DG3, Series 4081, Fluorescent Yellow
3. 3M Diamond Grade, DG3, Series 4083, Fluorescent Yellow/Green
4. 3M Diamond Grade, DG3, Series 4084, Fluorescent Orange
5. Avery Dennison, OmniCube, T-11500 Series
6. Avery Dennison, OmniCube, T-11511, Fluorescent Yellow
7. Avery Dennison, OmniCube, T-11513, Fluorescent Yellow Green
8. Avery Dennison, OmniCube, W-11514 Fluorescent Orange

**SPECIALTY SIGNS**

1. Reflexite "Endurance" Work Zone Sign (with Semi-Rigid Plastic Substrate)

**ALTERNATIVE SIGN SUBSTRATES**

**Fiberglass Reinforced Plastic (FRP) and Expanded Foam PVC**

1. Fiber-Brite (FRP)
2. Sequentia, "Polyplate" (FRP)
3. Inteplast Group "InteCel" (0.5 inch for Post-Mounted CZ Signs, 48-inch or less)(PVC)

**Aluminum Composite, Temporary Construction Signs and Permanent Signs up to 4 foot, 7 Inches**

1. Alcan Composites "Dibond Material, 80 mils"
2. Mitsubishi Chemical America, Alpollic 350
3. Bone Safety Signs, Bone Light ACM (temporary construction signs only)
4. Kommerling, USA, KomAlu 3 mm

**SECTION 8-2. CONCRETE**

**8-2.01 PORTLAND CEMENT CONCRETE**

Portland cement concrete shall conform to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications and these special provisions.

**STRENGTH DEVELOPMENT TIME**

The time allowed to obtain the minimum required compressive strength as specified in Section 90-1.01, "Description," of the Standard Specifications will be 56 days when the Contractor chooses cementitious material that satisfies the following equation:

$$\frac{(41 \times UF) + (19 \times F) + (11 \times SL)}{TC} \geq 7.0$$

Where:

- F = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N, including the amount in blended cement, pounds per cubic yard. F is equivalent to the sum of FA and FB as defined in Section 90-2.01C, "Required Use of Supplementary Cementitious Materials," of the Standard Specifications
- SL = GGBFS, including the amount in blended cement, pounds per cubic yard
- UF = Silica fume, metakaolin, or UFFA, including the amount in blended cement, pounds per cubic yard
- TC = Total amount of cementitious material used, pounds per cubic yard

For concrete satisfying the equation above, the Contractor shall test for the modulus of rupture or compressive strength specified for the concrete involved, at least once every 500 cubic yards, at 28, 42, and 56 days. The Contractor shall submit test results to the Engineer and the Transportation Laboratory, Attention: Office of Concrete Materials.

### SUPPLEMENTARY CEMENTITIOUS MATERIALS

The Contractor may use rice hull ash as a supplementary cementitious material (SCM) to make minor concrete. Rice hull ash shall conform to the requirements in AASHTO Designation: M 321 and the following chemical and physical requirements:

| Chemical Requirements                            | Percent |
|--|---------|
| Silicon Dioxide (SiO <sub>2</sub> ) <sup>a</sup> | 90 Min  |
| Loss on ignition                                 | 5.0 Max |
| Total Alkalies (as Na <sub>2</sub> O) equivalent | 3.0 Max |

| Physical Requirements  | Percent                    |
|--|----------------------------|
| Particle size distribution   |                            |
| Less than 45 microns   | 95                         |
| Less than 10 microns   | 50                         |
| Strength Activity Index with portland cement <sup>b</sup>                                    |                            |
| 7 days   | 95 (minimum % of control)  |
| 28 days  | 110 (minimum % of control) |
| Expansion at 16 days when testing job materials in conformance with ASTM C 1567 <sup>c</sup> | 0.10 Max                   |
| Surface Area when testing by nitrogen adsorption in conformance with ASTM D 5604             | 40.0 m <sup>2</sup> /g Min |

Notes:

<sup>a</sup> A maximum of 1.0% of the SiO<sub>2</sub> may exist in crystalline form.

<sup>b</sup> When tested in conformance with the requirements for strength activity testing of silica fume in AASHTO Designation: M 307

<sup>c</sup> In the test mix, Type II or Type V portland cement shall be replaced with at least 12% RHA by weight.

For the purposes of calculating cementitious material requirements in Section 90-2.01C, "Required Use of Supplementary Cementitious Materials," of the Standard Specifications and these special provisions, rice hull ash is considered to be represented by the variable *UF*.

### 8-2.02 CORROSION CONTROL FOR PORTLAND CEMENT CONCRETE

Portland cement concrete at CIDH concrete piling is considered to be in a corrosive environment and shall conform to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications and these special provisions, except the specifications for supplementary cementitious material content in Section 90-2.01C, "Required Use Of Supplementary Cementitious Materials," of the Standard Specifications shall not apply.

Cementitious material to be used in portland cement concrete shall conform to the provisions in Section 90-2, "Materials," of the Standard Specifications, and shall be a combination of either Type II or Type V portland cement and supplementary cementitious material.

Concrete in a corrosive environment shall contain not less than 675 pounds of cementitious material per cubic yard.

Reduction in the cementitious material content specified or ordered in conformance with the provisions in Section 90-4.05, "Optional Use of Chemical Admixtures," of the Standard Specifications, is not permitted for concrete in a corrosive environment.

For concrete in a corrosive environment, the cementitious material shall be comprised of one of the following:

- A. 25 percent by weight of either fly ash or natural pozzolan with a CaO content of up to 10 percent, and 75 percent by weight of portland cement
- B. 20 percent by weight of either fly ash or natural pozzolan with a CaO content of up to 10 percent, 5 percent by weight of silica fume, and 75 percent by weight of portland cement
- C. 12 percent by weight of either silica fume, metakaolin, or UFFA; and 88 percent by weight of portland cement
- D. 50 percent by weight of ground granulated blast furnace slag, and 50 percent by weight of portland cement

For the concrete at CIDH concrete piling, the ratio of the amount of free water to the amount of cementitious material used in concrete in a corrosive environment shall not exceed 0.40.

Full compensation for conforming to the above requirements shall be considered as included in the contract prices paid for the various contract items of work, and no additional compensation will be allowed therefor.

## **SECTION 8-3. WELDING**

### **8-3.01 WELDING**

#### **GENERAL**

Unless otherwise specified, Section 8-3, "Welding," shall apply to any welding that is specified to conform to an AWS welding code.

Requirements of the AWS welding codes shall apply unless otherwise specified in the Standard Specifications, on the plans, or in these special provisions. Wherever the abbreviation AWS is used, it shall be equivalent to the abbreviations ANSI/AWS or AASHTO/AWS.

Wherever reference is made to the following AWS welding codes in the Standard Specifications, on the plans, or in these special provisions, the year of adoption for these codes shall be as listed:

| AWS Code | Year of Adoption |
|----------|------------------|
| D1.1     | 2008             |
| D1.3     | 2008             |
| D1.4     | 2005             |
| D1.5     | 2008             |
| D1.6     | 2007             |
| D1.8     | 2009             |

Flux cored welding electrodes conforming to the requirements of AWS A5.20 E6XT-4 or E7XT-4 shall not be used to perform welding for this project.

Unless otherwise specified, Clause 6.1.3 of AWS D1.1, paragraph 1 of Section 7.1.2 of AWS D1.4, and Clause 6.1.1.2 of AWS D1.5, are replaced with the following:

The QC Inspector shall be the duly designated person who acts for and on behalf of the Contractor for inspection, testing, and quality related matters for all welding.

Quality Assurance (QA) is the prerogative of the Engineer. The QA Inspector is the duly designated person who acts for and on behalf of the Engineer.

The QC Inspector shall be responsible for quality control acceptance or rejection of materials and workmanship.

When the term "Inspector" is used without further qualification, it shall refer to the QC Inspector.

Inspection and approval of all joint preparations, assembly practices, joint fit-ups, welding techniques, and the performance of each welder, welding operator, and tack welder shall be documented by the QC Inspector on a daily basis for each day welding is performed. For each inspection, including fit-up, Welding Procedure Specification (WPS) verification, and final weld inspection, the QC Inspector shall confirm and document compliance with the requirements of the AWS or other specified code criteria and the requirements of these special provisions on all welded joints before welding, during welding, and after the completion of each weld.

The Engineer shall have the authority to verify the qualifications or certifications of any welder, QC Inspector, or NDT personnel to specified levels by retests or other means approved by the Engineer.

When joint weld details that are not prequalified to the details of Clause 3 of AWS D1.1 or to the details of Figure 2.4 or 2.5 of AWS D1.5 are proposed for use in the work, the joint details, their intended locations, and the proposed welding parameters and essential variables, shall be approved by the Engineer. The Contractor shall allow the Engineer 15 days to complete the review of the proposed joint detail locations.

In addition to the requirements of AWS D1.1, welding procedure qualifications for work welded in conformance with this code shall conform to the following:

When a nonstandard weld joint is to be made using a combination of WPSs, a single test may be conducted combining the WPSs to be used in production, provided the essential variables, including weld bead placement, of each process are limited to those established in Table 4.5.

Upon approval of the proposed joint detail locations and qualification of the proposed joint details, welders and welding operators using these details shall perform a qualification test plate using the WPS variables and the joint detail to be used in production. The test plate shall have the maximum thickness to be used in production and a minimum length of 18 inches. The test plate shall be mechanically and radiographically tested. Mechanical and radiographic testing and acceptance criteria shall be as specified in the applicable AWS codes.

The Engineer will witness all qualification tests for WPSs that were not previously approved by the Department.

In addition to the requirements specified in the applicable code, the period of effectiveness for a welder's or welding operator's qualification shall be a maximum of 3 years for the same weld process, welding position, and weld type. If welding will be performed without gas shielding, then qualification shall also be without gas shielding. Excluding welding of fracture critical members, a valid qualification at the beginning of work on a contract will be acceptable for the entire period of the contract, as long as the welder's or welding operator's work remains satisfactory.

The Contractor shall notify the Engineer 7 days prior to performing any procedure qualification tests. Witnessing of qualification tests by the Engineer shall not constitute approval of the intended joint locations, welding parameters, or essential variables. The Contractor shall notify the Engineer using the "Standard TL-38 Inspection Form" located at:

<http://www.dot.ca.gov/hq/esc/Translab/OSM/smbforms.htm>

Clause 6.14.6, "Personnel Qualification," of AWS D1.1, Section 7.8, "Personnel Qualification," of AWS D1.4, and Clause 6.1.3.4, "Personnel Qualification," of AWS D1.5 are replaced with the following:

Personnel performing nondestructive testing (NDT) shall be qualified and certified in conformance with the requirements of the American Society for Nondestructive Testing (ASNT) Recommended Practice No. SNT-TC-1A and the Written Practice of the NDT firm. The Written Practice of the NDT firm shall meet or exceed the guidelines of the ASNT Recommended Practice No. SNT-TC-1A. Individuals who perform NDT, review the results, and prepare the written reports shall be either:

- A. Certified NDT Level II technicians, or;
- B. Level III technicians who hold a current ASNT Level III certificate in that discipline and are authorized and certified to perform the work of Level II technicians.

Clause 6.6.5, "Nonspecified NDT Other than Visual," of AWS D1.1, Section 7.6.5 of AWS D1.4 and Clause 6.6.5 of AWS D1.5 shall not apply.

For any welding, the Engineer may direct the Contractor to perform NDT that is in addition to the visual inspection or NDT specified in the AWS or other specified welding codes, in the Standard Specifications, or in these special provisions. Except as provided for in these special provisions, additional NDT required by the Engineer, and associated repair work, will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications. Prior to release of welded material by the Engineer, if testing by NDT methods other than those

originally specified discloses an attempt to defraud or reveals a gross nonconformance, all costs associated with the repair of the deficient area, including NDT of the weld and of the repair, and any delays caused by the repair, shall be at the Contractor's expense. A gross nonconformance is defined as the sum of planar type rejectable indications in more than 20 percent of the tested length.

When less than 100 percent of NDT is specified for any weld, it is expected that the entire length of weld meet the specified acceptance-rejection criteria. Should any welding deficiencies be discovered by additional NDT directed or performed by the Engineer that utilizes the same NDT method as that originally specified, all costs associated with the repair of the deficient area, including NDT of the weld and of the weld repair, and any delays caused by the repair, shall be at the Contractor's expense.

Repair work to correct welding deficiencies discovered by visual inspection directed or performed by the Engineer, and any associated delays or expenses caused to the Contractor by performing these repairs, shall be at the Contractor's expense.

### **WELDING QUALITY CONTROL**

Welding quality control shall conform to the requirements in the AWS or other specified welding codes, the Standard Specifications, and these special provisions.

Unless otherwise specified, welding quality control shall apply to work welded in conformance with the provisions in the following:

- A. Section 49, "Piling," Section 52, "Reinforcement," Section 55, "Steel Structures," and Section 75-1.035, "Bridge Joint Restrainer Units," of the Standard Specifications
- B. "Structural Steel for Building Work" of these special provisions

Unless otherwise specified, Clauses 6.1.4.1 and 6.1.4.3 of AWS D1.1, paragraph 2 of Section 7.1.2 of AWS D1.4, and Clauses 6.1.3.2 through 6.1.3.3 of AWS D1.5 are replaced with the following:

The QC Inspector shall be currently certified as an AWS Certified Welding Inspector (CWI) in conformance with the requirements in AWS QC1, "Standard for AWS Certification of Welding Inspectors."

The QC Inspector may be assisted by an Assistant QC Inspector provided that this individual is currently certified as an AWS Certified Associate Welding Inspector (CAWI) in conformance with the requirements in AWS QC1, "Standard for AWS Certification of Welding Inspectors." The Assistant QC Inspector may perform inspection under the direct supervision of the QC Inspector provided the assistant is always within visible and audible range of the QC Inspector. The QC Inspector shall be responsible for signing all reports and for determining if welded materials conform to workmanship and acceptance criteria. The ratio of QC Assistants to QC Inspectors shall not exceed 5 to 1.

The Contractor shall designate in writing a welding Quality Control Manager (QCM). The QCM shall be responsible directly to the Contractor for the quality of welding, including materials and workmanship, performed by the Contractor and subcontractors.

The QCM shall be the sole individual responsible to the Contractor for submitting, receiving, reviewing, and approving all correspondence, required submittals, and reports to and from the Engineer. The QCM shall be a registered professional engineer or shall be currently certified as a CWI.

Unless the QCM is hired by a subcontractor providing only QC services, the QCM shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors, who will provide other services or materials for the project. The QCM may be an employee of the Contractor.

The QCM shall sign and furnish to the Engineer, a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each item of work for which welding was performed. The certificate shall state that all of the materials and workmanship incorporated in the work, and all required tests and inspections of this work, have been performed in conformance with the details shown on the plans, the Standard Specifications, and these special provisions.

Welding inspection personnel or NDT firms to be used in the work shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors, who will provide other services or materials for the project, except for the following conditions:

- A. The work is welded in conformance with AWS D1.5 and is performed at a permanent fabrication or manufacturing facility that is certified under the AISC Quality Certification Program, Category CBR, Major Steel Bridges and Fracture Critical endorsement F, when applicable.
- B. Structural steel for building work is welded in conformance with AWS D1.1 and is performed at a permanent fabrication or manufacturing facility that is certified under the AISC Quality Certification Program, Category STD, Standard for Steel Building Structures.

For welding performed at such facilities, the inspection personnel or NDT firms may be employed or compensated by the facility performing the welding provided the facility maintains a QC program that is independent from production.

Unless otherwise specified, an approved independent third party will witness the qualification tests for welders or welding operators. The independent third party shall be a current CWI and shall not be an employee of the contractor performing the welding. The Contractor shall allow the Engineer 15 days to review the qualifications and copy of the current certification of the independent third party.

Prior to submitting the Welding Quality Control Plan (WQCP) required herein, a prewelding meeting between the Engineer, the Contractor's QCM, and a representative from each entity performing welding or inspection for this project, shall be held to discuss the requirements for the WQCP.

Information regarding the contents, format, and organization of a WQCP, is available at the Transportation Laboratory and at:

<http://www.dot.ca.gov/hq/esc/Translab/OSM/smbresources.htm>

The Contractor shall submit to the Engineer, in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications, 2 copies of a separate WQCP for each subcontractor or supplier for each item of work for which welding is to be performed.

The Contractor shall allow the Engineer 15 days to review the WQCP submittal after a complete plan has been received. No welding shall be performed until the WQCP is approved in writing by the Engineer.

An amended WQCP or any addendum to the approved WQCP shall be submitted to, and approved in writing by the Engineer, for proposed revisions to the approved WQCP. An amended WQCP or addendum will be required for revisions to the WQCP, including but not limited to a revised WPS; additional welders; changes in NDT firms, QC, or NDT personnel or procedures; or updated systems for tracking and identifying welds. The Engineer shall have 7 days to complete the review of the amended WQCP or addendum. Work affected by the proposed revisions shall not be performed until the amended WQCP or addendum has been approved.

After final approval of the WQCP, amended WQCP, or addendum, the Contractor shall submit 7 copies to the Engineer of the approved documents. A copy of the Engineer approved document shall be available at each location where welding is to be performed.

All welding will require inspection by the Engineer. The Contractor shall request inspection at least 3 business days prior to the beginning of welding for locations within California and 5 business days for locations outside of California. The Contractor shall request inspection at:

<http://www.dot.ca.gov/hq/esc/Translab/OSM/smbforms.htm>

Continuous inspection shall be provided when any welding is being performed. Continuous inspection, as a minimum, shall include having a QC Inspector within such close proximity of all welders or welding operators so that inspections by the QC Inspector of each welding operation at each welding location does not lapse for a period exceeding 30 minutes.

A daily production log for welding shall be kept for each day that welding is performed. The log shall clearly indicate the locations of all welding. The log shall include the welders' names, amount of welding performed, any problems or deficiencies discovered, and any testing or repair work performed, at each location. The daily report from each QC Inspector shall also be included in the log.

The following items shall be included in a Welding Report that is to be submitted to the Engineer within 15 days following the performance of any welding:

- A. A daily production log.
- B. Reports of all visual weld inspections and NDT.
- C. Radiographs and radiographic reports, and other required NDT reports.
- D. A summary of welding and NDT activities that occurred during the reporting period.
- E. Reports of each application of heat straightening.
- F. A summarized log listing the rejected lengths of weld by welder, position, process, joint configuration, and piece number.
- G. Documentation that the Contractor has evaluated all radiographs and other nondestructive tests and corrected all rejectable deficiencies, and that all repaired welds have been reexamined using the required NDT and found acceptable.

The following information shall be clearly written on the outside of radiographic envelopes: name of the QCM, name of the nondestructive testing firm, name of the radiographer, date, contract number, complete part description, and all included weld numbers, report numbers, and station markers or views, as detailed in the WQCP. In addition, all interleaves shall have clearly written on them the part description and all included weld numbers and station markers or views, as detailed in the WQCP. A maximum of 2 pieces of film shall be used for each interleave.

Reports of all visual inspections and NDT shall be signed by the inspector or technician and submitted daily to the QCM for review and signature prior to submittal to the Engineer. Corresponding names shall be clearly printed or typewritten next to all signatures. Reports of all NDT, whether specified, additional, or informational, performed by the Contractor shall be submitted to the Engineer.

The Engineer will review the Welding Report to determine if the Contractor is in conformance with the WQCP. Except for field welded steel pipe piling, the Engineer shall be allowed 15 days to review the report and respond in writing after the complete Welding Report has been received. Prior to receiving notification from the Engineer of the Contractor's conformance with the WQCP, the Contractor may encase in concrete or cover welds for which the Welding Report has been submitted. However, should the Contractor elect to encase or cover those welds prior to receiving notification from the Engineer, it is expressly understood that the Contractor shall not be relieved of the responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Material not conforming to these requirements will be subject to rejection.

For field welded steel pipe piling, including bar reinforcement in the piling, the Contractor shall allow the Engineer 2 business days to review the Welding Report and respond in writing after the required items have been received. No field welded steel pipe piling shall be installed, and no reinforcement in the piling shall be encased in concrete until the Engineer has approved the above requirements in writing.

In addition to the requirements in AWS D1.1 and AWS D1.5, third-time excavations of welds or base metal to repair unacceptable discontinuities, regardless of NDT method, and all repairs of cracks require prior approval of the Engineer.

The Engineer shall be notified immediately in writing when welding problems, deficiencies, base metal repairs, or any other type of repairs not submitted in the WQCP are discovered, and also of the proposed repair procedures to correct them. For requests to perform third-time excavations or repairs of cracks, the Contractor shall include an engineering evaluation of the proposed repair. The engineering evaluation, at a minimum, shall address the following:

- A. What is causing each defect?
- B. Why the repair will not degrade the material properties?
- C. What steps are being taken to prevent similar defects from happening again?

The Contractor shall allow the Engineer 7 days to review these procedures. No remedial work shall begin until the repair procedures are approved in writing by the Engineer.

Clause 6.5.4 of AWS D1.5 is replaced with the following:

The QC Inspector shall inspect and approve each joint preparation, assembly practice, welding technique, joint fit-up, and the performance of each welder, welding operator, and tack welder to make certain that the applicable requirements of this code and the approved Welding Procedure Specification (WPS) are met. The QC Inspector shall examine the work to make certain that it meets the requirements of Clauses 3 and 6.26. The size and contour of all welds shall be measured using suitable gages. Visual inspection for cracks in welds and base metal, and for other discontinuities shall be aided by strong light, magnifiers, or such other devices as may

be helpful. Acceptance criteria different from those specified in this code may be used when approved by the Engineer.

In addition to the requirements of AWS D1.5, Clause 5.12 or 5.13, welding procedures qualification for work welded in conformance with that code shall conform to the following requirements:

- A. Unless considered prequalified, fillet welds shall be qualified in each position. The fillet weld soundness test shall be conducted using the essential variables of the WPS as established by the Procedure Qualification Record (PQR).
- B. For qualification of joints that do not conform to Figures 2.4 and 2.5 of AWS D1.5, a minimum of 2 WPS qualification tests are required. The tests shall be conducted using both Figure 5.1 and Figure 5.3. The test conforming to Figure 5.1 shall be conducted in conformance with AWS D1.5, Clause 5.12 or 5.13. The test conforming to Figure 5.3 shall be conducted using the welding electrical parameters that were established for the test conducted conforming to Figure 5.1. The ranges of welding electrical parameters established during welding per Figure 5.1 in conformance with AWS D1.5, Clause 5.12, shall be further restricted according to the limits in Table 5.3 during welding per Figure 5.3.
- C. Multiple zones within a weld joint may be qualified. The travel speed, amperage, and voltage values that are used for tests conducted per AWS D1.5 Clause 5.13 shall be consistent for each pass in a weld joint, and shall in no case vary by more than  $\pm 10$  percent for travel speed,  $\pm 10$  percent for amperage, and  $\pm 7$  percent for voltage as measured from a predetermined target value or average within each weld pass or zone. The travel speed shall in no case vary by more than  $\pm 15$  percent when using submerged arc welding.
- D. For a WPS qualified in conformance with AWS D1.5 Clause 5.13, the values to be used for calculating ranges for current and voltage shall be based on the average of all weld passes made in the test. Heat input shall be calculated using the average of current and voltage of all weld passes made in the test for a WPS qualified in conformance with Clause 5.12 or 5.13.
- E. Macroetch tests are required for WPS qualification tests, and acceptance shall be per AWS D1.5 Clause 5.19.3.
- F. When a nonstandard weld joint is to be made using a combination of WPSs, a test conforming to Figure 5.3 may be conducted combining the WPSs to be used in production, provided the essential variables, including weld bead placement, of each process are limited to those established in Table 5.3.
- G. Prior to preparing mechanical test specimens, the PQR welds shall be inspected by visual and radiographic tests. Backing bar shall be 3 inches in width and shall remain in place during NDT testing. Results of the visual and radiographic tests shall comply with AWS D1.5 Clause 6.26.2, excluding Clause 6.26.2.2. Test plates that do not comply with both tests shall not be used.

## **WELDING FOR OVERHEAD SIGN AND POLE STRUCTURES**

The Contractor shall meet the following requirements for any work welded in conformance with the provisions in Section 56-1, "Overhead Sign Structures," or Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications.

Welding inspection personnel or NDT firms to be used in the work shall not be employed or compensated by any subcontractor or by other persons or entities hired by subcontractors who will provide other services or materials for the project except for when the welding is performed at a permanent fabrication or manufacturing facility that is certified under the AISC Quality Certification Program. The AISC Certification category for overhead sign structures shall be Simple Steel Bridge Structures (SBR), and the AISC Certification category for pole structures shall be Simple Steel Bridge Structures (SBR) or Standard for Steel Building Structures (STD).

### **Welding Qualification Audit**

Contractors or subcontractors performing welding operations for overhead sign and pole structures shall have successfully completed the Department's "Manufacturing Qualification Audit for Overhead Sign and Pole Structures." Copies of the audit form and procedures for requesting and completing the audit are available at:

<http://www.dot.ca.gov/hq/esc/Translab/OSM/smbresources.htm>

An audit that was approved by the Engineer no more than 3 years prior to the award of the contract will be acceptable for the entire period of this contract provided the Engineer determines the audit was for the same type of work that is to be performed on this contract.



A list of facilities that have successfully completed the audit and are authorized to provide material for this contract is available at:

[http://www.dot.ca.gov/hq/esc/Translab/OSM/smdocuments/Internet\\_auditlisting.pdf](http://www.dot.ca.gov/hq/esc/Translab/OSM/smdocuments/Internet_auditlisting.pdf)

Successful completion of an audit shall not relieve the Contractor of the responsibility for furnishing materials or producing finished work of the quality specified in these special provisions and as shown on the plans.

### **Welding Report**

For work welded in conformance with the provisions in Section 56-1, "Overhead Sign Structures," or Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications, a Welding Report shall be submitted in conformance with the provisions in "Welding Quality Control" of these special provisions.

### **PAYMENT**

Full compensation for conforming to the requirements of "Welding" shall be considered as included in the contract prices paid for the various items of work involved and no additional compensation will be allowed therefor.

## **SECTION 9. (BLANK)**

## **SECTION 10. CONSTRUCTION DETAILS**

### **SECTION 10-1. GENERAL**

#### **10-1.01 ORDER OF WORK**

Order of work shall conform to the provisions in Section 5-1.05, "Order of Work," of the Standard Specifications and these special provisions.

Notify the Engineer 7 days before closing city streets, obstructing fire hydrants or bus stops.

The first order of work shall be to place the order for the electrical equipment.

Above ground electrical work shall not be performed on any system within the project site until all Contractor-Furnished electrical materials for that individual system have been delivered to the Contractor.

Model 334T controller cabinets shown with existing symbol in plans at the following locations are to be installed by others.

Location 1: El Camino Real and Whipple Ave

Location 4: El Camino Real and Ravenswood Ave

Location 7: Middlefield Ave and Route 84

El Camino Real and Jefferson Ave

Installation of the above cabinets will be done in the duration of this contract. Construction coordination and scheduling shall be made for work at these locations. The Engineer may furnish the cabinet installation schedule for construction convenience.

Attention is directed to "Maintaining Traffic" of these special provisions.

Before obliterating any pavement delineation (traffic stripes, pavement markings, and pavement markers) that is to be replaced on the same alignment and location, as determined by the Engineer, the pavement delineation shall be referenced by the Contractor, with a sufficient number of control points to reestablish the alignment and location of the new pavement delineation. The references shall include the limits or changes in striping pattern, including one- and 2-way barrier lines, limit lines, crosswalks and other pavement markings. Full compensation for referencing existing pavement delineation shall be considered as included in the contract lump sum price paid for fiber optic system and no additional compensation will be allowed therefor.

Prior to applying tack coat and hot mix asphalt, the Contractor shall cover all manholes, valve and monument covers, grates, or other exposed facilities located within the area of application, using a plastic or oil resistant construction paper secured to the facility being covered by tape or adhesive. The covered facilities shall be referenced by the Contractor, with a sufficient number of control points to relocate the facilities after the hot mix asphalt has been placed. After completion of the hot mix asphalt paving operation, all covers shall be removed and disposed of in a manner satisfactory to the Engineer. Full compensation for covering manholes, valve and monument covers, grates, or other exposed facilities, referencing, and removing temporary cover shall be considered

as included in the contract price paid per ton for hot mix asphalt (Type A), and no additional compensation will be allowed therefor.

At those locations exposed to public traffic where guard railings are to be constructed, the Contractor shall schedule operations so that at the end of each working day there shall be no post holes open nor shall there be any railing posts installed without the blocks and rail elements assembled and mounted thereon.

#### **10-1.02 ARCHAEOLOGICAL MONITORING AREA**

AMAs within, near, or straddling the project limits are shown on the plans.

#### **10-1.03 MATERIAL CONTAINING AERIALY DEPOSITED LEAD**

This work shall consist of handling material contaminated by aerially deposited lead in conformance with the Standard Specifications and these special provisions.

Aerially deposited lead is typically found within the top 2 feet of material in unpaved areas within the highway right of way. Levels of lead found near the project limits range from less than 0.5 mg/kg to 3000 mg/kg total as analyzed by EPA Test Method 6010 or EPA Test Method 7000 series.

After the Contractor has completed handling materials containing aerially deposited lead, in conformance with the plans, Standard Specifications, and these special provisions, the Contractor shall have no responsibility for such materials in place and shall not be obligated for further cleanup, removal, or remedial actions for such materials.

Handling material containing aerially deposited lead shall be in conformance with rules and regulations including, but not limited to, those of the following agencies:

California Division of Occupational Safety and Health Administration (Cal-OSHA)  
California Regional Water Quality Control Board, Region 2.

#### **LEAD COMPLIANCE PLAN**

The Contractor shall prepare a project specific Lead Compliance Plan under Section 7-1.07, "Lead Compliance Plan," of the Standard Specifications.

The contract lump sum price paid for Lead Compliance Plan shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in preparing the Lead Compliance Plan, including paying the Certified Industrial Hygienist, and for providing personal protective equipment, training and medical surveillance, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

#### **SOIL HANDLING**

Handling of materials containing aerially deposited lead shall result in no visible dust migration. The Contractor shall have a means of dust control available at all times while handling material in work areas containing aerially deposited lead. Apply water to prevent visible dust.

The Contractor shall separate material from vegetation and the soils shall remain on site. This will not be required for vegetation removal performed during plant establishment.

Surplus material excavated from areas containing aerially deposited lead shall remain in the area of soil disturbance. The surplus soil shall not be disposed of outside the highway right of way.

Full compensation for handling material contaminated with aerially deposited lead, except as otherwise provided, shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

#### **10-1.04 WATER POLLUTION CONTROL**

##### **GENERAL**

##### **Summary**

This work includes developing and implementing a water pollution control program (WPCP) for projects where soil disturbance from work activities will be one of the following:

1. Less than 1 acre
2. Less than 5 acres if the project has an Environmental Protection Agency Small Construction Project Erosivity Waiver referred to herein as "Erosivity Waiver"

Information on forms, reports, and other documents can be found in the following Department manuals:

1. Field Guide for Construction Site Dewatering
2. Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual
3. Construction Site Best Management Practices (BMP) Manual

For the above-referenced manuals, go to the Department's Web site for the Division of Construction, Storm Water and Water Pollution Control Information or the Department's Publication Distribution Unit.

Do not start job site activities until:

1. The WPCP is approved.
2. WPCP review requirements have been fulfilled. If the Regional Water Quality Control Board (RWQCB) requires time for review, allow 30 days for the review. For projects in the Lake Tahoe Hydrologic Unit and the Mammoth Lakes Hydrologic Unit, the Lahontan RWQCB will review the WPCP.

If you operate a Contractor-support facility, protect stormwater systems and receiving waters from the discharge of potential pollutants by using water pollution control practices.

Contractor-support facilities include:

1. Staging areas
2. Storage yards for equipment and materials
3. Mobile operations
4. Batch plants for PCC and HMA
5. Crushing plants for rock and aggregate
6. Other facilities installed for your convenience, such as haul roads

Discharges from manufacturing facilities, such as batch plants and crushing plants, must comply with the general waste discharge requirements for Order No. 97-03-DWQ, NPDES General Permit No. CAS000001, issued by the State Water Resources Control Board (SWRCB) for "Discharge of Storm Water Associated with Industrial Activities Excluding Construction Activities" and referred to herein as "General Industrial Permit." For the General Industrial Permit, go to the Web site for the SWRCB.

If you operate a batch plant to manufacture PCC, HMA, or other material or a crushing plant to produce rock or aggregate, obtain coverage under the General Industrial Permit. You must be covered under the General Industrial Permit for batch plants and crushing plants located:

1. Outside of the job site
2. Within the job site that serve 1 or more contracts

If you obtain or dispose of material at a noncommercially operated borrow or disposal site, prevent water pollution due to erosion at the site during and after completion of your activities. Upon completion of your work, leave the site in a condition such that water will not collect or stand therein.

The Department does not pay for water pollution control practices at Contractor-support facilities and noncommercially operated borrow or disposal sites.

### Definitions

**construction phase:** Includes (1) highway construction phase for building roads and structures, (2) plant establishment and maintenance phase for placing vegetation for final stabilization, and (3) suspension phase for suspension of work activities or winter shutdown. The construction phase continues from the start of work activities to contract acceptance.

**inactive area:** Area where soil-disturbing work activities have not occurred within 15 days.

**qualifying rain event:** Storm that produces at least 0.5 inch of precipitation with a 48-hour or greater period between rain events.

**storm event:** Storm that produces or is forecasted to produce at least 0.10 inch of precipitation within a 24-hour period.

## **Submittals**

### **General**

Within 7 days after contract approval:

1. Submit 2 copies of your WPCP for review. Allow 15 days for the Department's review. The Engineer provides comments and specifies the date when the review stopped if revisions are required.
2. Resubmit a revised WPCP within 7 days of receiving the Engineer's comments. The Department's review resumes when the complete WPCP has been resubmitted.
3. When the Engineer approves the WPCP, submit an electronic copy and 3 printed copies of the approved WPCP.
4. If the RWQCB requires review of the approved WPCP, the Engineer submits the approved WPCP to the RWQCB for its review and comment.
5. If the Engineer orders changes to the WPCP based on the RWQCB's comments, amend the WPCP within 3 business days.

A qualified SWPPP practitioner (QSP) or qualified SWPPP developer (QSD) must prepare the WPCP.

The WPCP must comply with the Department's Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Plan (WPCP) Preparation Manual and must:

1. Show the location of disturbed soil areas, water bodies, and water conveyances
2. Describe the work involved in the installation, maintenance, repair, and removal of temporary water pollution control practices
3. Show the locations and types of water pollution control practices that will be used for:
  - 3.1. Stormwater and nonstormwater in areas outside the job site but related to work activities, including:
    - 3.1.1. Staging areas
    - 3.1.2. Storage yards
    - 3.1.3. Access roads
  - 3.2. Activities or mobile activities related to all NPDES permits
  - 3.3. Contractor-support facilities
4. Show the locations and types of temporary water pollution control practices that will be used in the work for each construction phase
5. Show the locations and types of water pollution control practices that will be installed permanently under the contract
6. Include a schedule showing when:
  - 6.1. Work activities will be performed that could cause the discharge of pollutants into stormwater
  - 6.2. Water pollution control practices associated with each construction phase will be implemented
  - 6.3. Soil stabilization and sediment control practices for disturbed soil areas will be implemented
7. Include a copy of permits obtained by the Department, including Fish & Game permits, US Army Corps of Engineers permits, RWQCB 401 certifications, aerially deposited lead variance from the Department of Toxic Substance Control, aerially deposited lead variance notification, and RWQCB waste discharge requirements for aerially deposited lead reuse

Amend the WPCP whenever:

1. Changes in work activities could affect the discharge of pollutants
2. Water pollution control practices are added by Contract Change Order
3. Water pollution control practices are added at your discretion
4. Changes in the quantity of disturbed soil are substantial
5. Objectives for reducing or eliminating pollutants in stormwater discharges have not been achieved
6. Project receives a written notice or order from the RWQCB or any other regulatory agency

Allow the same review time for amendments to the WPCP as for the original WPCP.

### **Information After Storm Event**

Within 48 hours after the conclusion of a storm event resulting in a discharge, after a nonstormwater discharge, or after receiving a written notice or an order from the RWQCB or another regulatory agency, the WPC manager must submit the following information:

1. Date, time, location, and nature of the activity and the cause of the notice or order
2. Type and quantity of discharge
3. Water pollution control practices in use before the discharge or before receiving the notice or order
4. Description of water pollution control practices and corrective actions taken to manage the discharge or cause of the notice

### **Training Records**

Submit water pollution control training records for all employees and subcontractors who will be working at the job site. Include the training subjects, training dates, ongoing training, and tailgate meetings with your submittal. Submit records for:

1. Existing employees within 5 business days of obtaining WPCP approval
2. New employees within 5 business days of receiving the training
3. A subcontractor's employees at least 5 business days before the subcontractor starts work

### **Contractor-support Facility**

At least 5 business days before operating any Contractor-support facility, submit:

1. A plan showing the location and quantity of water pollution control practices associated with the Contractor-support facility
2. A copy of the notice of intent approved by the RWQCB and the WPCP approved by the RWQCB if you will be operating a batch plant or a crushing plant under the General Industrial Permit

### **Quality Control and Assurance**

#### **Training**

Employees must receive initial water pollution control training before starting work at the job site.

For your project managers, supervisory personnel, subcontractors, and employees involved in water pollution control work:

1. Provide stormwater training in the following subjects:
  - 1.1. Water pollution control rules and regulations
  - 1.2. Implementation and maintenance for:
    - 1.2.1. Temporary soil stabilization
    - 1.2.2. Temporary sediment control
    - 1.2.3. Tracking control
    - 1.2.4. Wind erosion control
    - 1.2.5. Material pollution prevention and control
    - 1.2.6. Waste management
    - 1.2.7. Nonstormwater management
2. Conduct weekly training meetings covering:
  - 2.1. Deficiencies and corrective actions for water pollution control practices
  - 2.2. Water pollution control practices required for work activities during the week
  - 2.3. Spill prevention and control
  - 2.4. Material delivery, storage, usage, and disposal
  - 2.5. Waste management
  - 2.6. Nonstormwater management procedures

## **Water Pollution Control Manager**

### **General**

The water pollution control (WPC) manager must be a QSP or QSD. Assign 1 WPC manager to implement the WPCP. You may assign a QSP or QSD other than the WPC manager to develop the WPCP.

### **Qualifications**

A QSP must:

1. Have completed stormwater management training described in the Department's Web site for the Division of Construction, Storm Water and Water Pollution Control Information
2. Be certified for at least one of the following:
  - 2.1. Certified Erosion, Sediment and Storm Water Inspector (CESSWI)<sup>TM</sup> registered through Enviro Cert International, Inc.
  - 2.2. Certified Inspector of Sediment and Erosion Control (CISEC) registered through CISEC, Inc.
3. Have completed SWRCB approved QSP training and passed the QSP exam

A QSD must:

1. Have completed stormwater management training described in the Department's Web site for the Division of Construction, Storm Water and Water Pollution Control Information
2. Be one or more of the following:
  - 2.1. California registered civil engineer
  - 2.2. California registered professional geologist or engineering geologist
  - 2.3. California licensed landscape architect
  - 2.4. Professional hydrologist registered through the American Institute of Hydrology
  - 2.5. Certified Professional in Erosion and Sediment Control (CPESC)<sup>TM</sup> registered through Enviro Cert International, Inc.
  - 2.6. Certified Professional in Storm Water Quality (CPSWQ)<sup>TM</sup> registered through Enviro Cert International, Inc.
  - 2.7. Professional in erosion and sediment control registered through the National Institute for Certification in Engineering Technologies (NICET)
3. Have completed SWRCB approved QSD training and passed the QSD exam

### **Responsibilities**

The WPC manager must:

1. Be responsible for water pollution control work
2. Be the primary contact for water pollution control work
3. Oversee:
  - 3.1. Maintenance of water pollution control practices
  - 3.2. Inspections of water pollution control practices identified in the WPCP
  - 3.3. Inspections and reports for visual monitoring
  - 3.4. BMP status reports
4. Oversee and enforce hazardous waste management practices including spill prevention and control measures
5. Have authority to mobilize crews to make immediate repairs to water pollution control practices
6. Ensure that all employees have current water pollution control training
7. Implement the approved WPCP
8. Amend the WPCP if required
9. Be at the job site within 2 hours of being contacted
10. Have the authority to stop construction activities damaging water pollution control practices or causing water pollution

## **MATERIALS**

Not Used

## **CONSTRUCTION**

### **General**

Manage work activities in a way that reduces the discharge of pollutants to surface waters, groundwater, and separate municipal storm sewer systems.

Continue WPCP implementation during any suspension of work activities.

You are responsible for delays and you must pay all costs associated with submitting a SWPPP due to your actions that result in one of the following:

1. 1 or more acres of soil disturbance on projects without an Erosivity Waiver
2. More than 5 acres of soil disturbance on projects with an Erosivity Waiver
3. Failure to comply with the schedule for soil disturbing activities for projects with an Erosivity Waiver if the delays void the Erosivity Waiver

Install facilities and devices used for water pollution control practices before performing work activities. Install soil stabilization materials for water pollution control practices in all inactive areas or before storm events.

Repair or replace water pollution control practices within 24 hours of discovering any damage, unless a longer period is authorized.

The Department does not pay for the cleanup, repair, removal, disposal, or replacement of water pollution control practices due to improper installation or your negligence.

You may request changes to the water pollution control work or the Engineer may order changes to water pollution control work. Changes may include additional or new water pollution control practices. Additional water pollution control work is paid for as extra work under Section 4-1.03D, "Extra Work," of the Standard Specifications.

Retain a printed copy of the approved WPCP at the job site.

### **Monitoring**

Monitor and inspect water pollution control practices at the job site.

Notify the Engineer within 6 hours whenever any of the following occurs:

1. You identify discharges into receiving waters or drainage systems that are causing or could cause water pollution
2. You receive a written notice or order for the project from the RWQCB or any other regulatory agency

Monitor the National Weather Service's forecast on a daily basis. For the National Weather Service's forecast, go to the Web site for the National Weather Service.

### **Inspections**

Use the Stormwater Site Inspection Report form for documenting site inspections.

The WPC manager must oversee:

1. Inspections of water pollution control practices identified in WPCP:
  - 1.1. Before a forecasted storm event
  - 1.2. After a qualifying rain event that produces site runoff
  - 1.3. At 24-hour intervals during extended storm events
  - 1.4. On a predetermined schedule of at least once a week
2. Daily inspections of:
  - 2.1. Storage areas for hazardous materials and waste
  - 2.2. Hazardous waste disposal and transporting activities
  - 2.3. Hazardous material delivery and storage activities

3. Inspections of:

3.1. Vehicle and equipment cleaning facilities:

- 3.1.1. Daily if vehicle and equipment cleaning occurs daily
- 3.1.2. Weekly if vehicle and equipment cleaning does not occur daily

3.2. Vehicle and equipment maintenance and fueling areas:

- 3.2.1. Daily if vehicle and equipment maintenance and fueling occurs daily
- 3.2.2. Weekly if vehicle and equipment maintenance and fueling does not occur daily

3.3. Vehicles and equipment at the job site for leaks and spills on a daily schedule. Verify that operators are inspecting vehicles and equipment each day of use.

3.4. Demolition sites within 50 feet of storm drain systems and receiving waters daily.

3.5. Pile driving areas for leaks and spills:

- 3.5.1. Daily if pile driving occurs daily
- 3.5.2. Weekly if pile driving does not occur daily

3.6. Temporary concrete washouts:

- 3.6.1. Daily if concrete work occurs daily
- 3.6.2. Weekly if concrete work does not occur daily

3.7. Paved roads at job site access points for street sweeping:

- 3.7.1. Daily if earthwork and other sediment or debris-generating activities occur daily
- 3.7.2. Weekly if earthwork and other sediment or debris-generating activities do not occur daily
- 3.7.3. Within 24 hours of precipitation forecasted by the National Weather Service

3.8. Dewatering work:

- 3.8.1. Daily if dewatering work occurs daily
- 3.8.2. Weekly if dewatering work does not occur daily

3.9. Temporary active treatment system:

- 3.9.1. Daily if temporary active treatment system activities occur daily
- 3.9.2. Weekly if temporary active treatment system activities do not occur daily

3.10. Work over water:

- 3.10.1. Daily if work over water occurs daily
- 3.10.2. Weekly if work over water does not occur daily

**Deficiencies**

Whenever you or the Engineer identify a deficiency in the implementation of the approved WPCP, correct the deficiency:

- 1. Immediately, unless a later date is authorized
- 2. Before precipitation occurs

The Department may correct the deficiency and deduct the cost of correcting the deficiency from payment if you fail to correct the deficiency by the agreed date or before the onset of precipitation.



## **MEASUREMENT AND PAYMENT**

The contract lump sum price paid for prepare water pollution control program includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in developing and implementing a WPCP, including providing a WPC manager, conducting water pollution control training, and monitoring, inspecting and correcting water pollution control practices, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The Department pays you for prepare water pollution control program as follows:

1. A total of 75 percent of the item total upon approval of the WPCP
2. A total of 100 percent of the item total upon contract acceptance

## **10-1.05 CONSTRUCTION SITE MANAGEMENT**

### **GENERAL**

#### **Summary**

This work includes preventing and controlling spills, dewatering, and managing materials, waste, and nonstormwater.

Implement effective handling, storage, usage, and disposal practices to control material pollution and manage waste and nonstormwater at the job site before they come in contact with storm drain systems and receiving waters.

The following abbreviations are used in this special provision:

DTSC: Department of Toxic Substance Control.

ELAP: Environmental Laboratory Accreditation Program.

WPC: Water Pollution Control.

#### **Submittals**

Before you start dewatering, submit a dewatering and discharge work plan under Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications and "Water Pollution Control" of these special provisions. The dewatering and discharge work plan must include:

1. Title sheet and table of contents
2. Description of dewatering and discharge activities detailing locations, quantity of water, equipment, and discharge point
3. Estimated schedule for dewatering and discharge start and end dates of intermittent and continuous activities
4. Discharge alternatives, such as dust control or percolation
5. Visual monitoring procedures with inspection log
6. Copy of written approval to discharge into a sanitary sewer system at least 5 business days before starting discharge activities

Submit the following:

1. Material Safety Data Sheet at least 5 business days before material is used or stored
2. Monthly inventory records for material used or stored

Submit written approval from the local health agency, city, county, and sewer district before discharging from a sanitary or septic system directly into a sanitary sewer system.

### **MATERIALS**

Not Used

### **CONSTRUCTION**

#### **Spill Prevention and Control**

##### **General**

Keep material or waste storage areas clean, well organized, and equipped with enough cleanup supplies for the material being stored.

Implement spill and leak prevention procedures for chemicals and hazardous substances stored on the job site. Whenever you spill or leak chemicals or hazardous substances at the job site, you are responsible for all associated cleanup costs and related liability.

Report minor, semi-significant, and significant or hazardous spills to the WPC manager. The WPC manager must notify the Engineer immediately.

As soon as it is safe, contain and clean up spills of petroleum materials and sanitary and septic waste substances listed under 40 CFR, Parts 110, 117, and 302.

### **Minor Spills**

Minor spills consist of quantities of oil, gasoline, paint, or other materials that are small enough to be controlled by a 1st responder upon discovery of the spill.

Clean up a minor spill using the following procedures:

1. Contain the spread of the spill
2. Recover the spilled material using absorption
3. Clean the contaminated area
4. Dispose of the contaminated material and absorbents promptly and properly under "Waste Management" of these special provisions

### **Semi-Significant Spills**

Semi-significant spills consist of spills that can be controlled by a 1st responder with help from other personnel. Clean up a semi-significant spill immediately using the following procedures:

1. Contain the spread of the spill.
2. On paved or impervious surfaces, encircle and recover the spilled material with absorbent materials. Do not allow the spill to spread widely.
3. If the spill occurs on soil, contain the spill by constructing an earthen dike and dig up the contaminated soil for disposal.
4. If the spill occurs during precipitation, cover the spill with 10-mil plastic sheeting or other material to prevent contamination of runoff.
5. Dispose of the contaminated material promptly and properly under "Waste Management" of these special provisions.

### **Significant or Hazardous Spills**

Significant or hazardous spills consist of spills that cannot be controlled by job site personnel. Immediately notify qualified personnel of a significant or hazardous spill. Take the following steps:

1. Do not attempt to clean up the spill until qualified personnel have arrived
2. Notify the Engineer and follow up with a report
3. Obtain the immediate services of a spill contractor or hazardous material team
4. Notify local emergency response teams by dialing 911 and county officials by using the emergency phone numbers retained at the job site
5. Notify the California Emergency Management Agency State Warning Center at (916) 845-8911
6. Notify the National Response Center at (800) 424-8802 regarding spills of Federal reportable quantities under 40 CFR 110, 119, and 302
7. Notify other agencies as appropriate, including:
  - 7.1. Fire Department
  - 7.2. Public Works Department
  - 7.3. Coast Guard
  - 7.4. Highway Patrol
  - 7.5. City Police or County Sheriff's Department
  - 7.6. Department of Toxic Substances
  - 7.7. California Division of Oil and Gas
  - 7.8. Cal/OSHA
  - 7.9. Regional Water Resources Control Board

Prevent a spill from entering stormwater runoff before and during cleanup activities. Do not bury or wash the spill with water.

## **Material Management**

### **General**

Minimize or eliminate discharge of material into the air, storm drain systems, and receiving waters while taking delivery of, using, or storing the following materials:

1. Hazardous chemicals, including acids, lime, glues, adhesives, paints, solvents, and curing compounds
2. Soil stabilizers and binders
3. Fertilizers
4. Detergents
5. Plaster
6. Petroleum materials, including fuel, oil, and grease
7. Asphalt and concrete components
8. Pesticides and herbicides

Employees trained in emergency spill cleanup procedures must be present during the unloading of hazardous materials or chemicals.

Use less hazardous materials if practicable.

The following activities must be performed at least 100 feet from concentrated flows of stormwater, drainage courses, and inlets if within the floodplain and at least 50 feet if outside the floodplain, unless otherwise approved by the Engineer:

1. Stockpiling materials
2. Storing pile-driving equipment and liquid waste containers
3. Washing vehicles and equipment in outside areas
4. Fueling and maintaining vehicles and equipment

### **Material Storage**

If materials are stored:

1. Store liquids, petroleum materials, and substances listed in 40 CFR 110, 117, and 302 and place them in secondary containment facilities as specified by US DOT for storage of hazardous materials.
2. Secondary containment facilities must be impervious to the materials stored there for a minimum contact time of 72 hours.
3. Cover secondary containment facilities during non-working days and whenever precipitation is forecasted. Secondary containment facilities must be adequately ventilated.
4. Keep secondary containment facilities free of accumulated rainwater or spills. After precipitation, or in the event of spills or leaks, collect accumulated liquid and place it into drums within 24 hours. Handle the liquid as hazardous waste under "Waste Management" of these special provisions unless testing confirms that the liquid is nonhazardous.
5. Do not store incompatible materials, such as chlorine and ammonia, in the same secondary containment facility.
6. Store materials in their original containers with the original material labels maintained in legible condition. Immediately replace damaged or illegible labels.
7. Secondary containment facilities must have the capacity to contain precipitation from a 24-hour-long, 25-year storm, plus 10 percent of the aggregate volume of all containers or the entire volume of the largest container within the facility, whichever is greater.
8. Store bagged or boxed material on pallets. Protect bagged or boxed material from wind and rain during non-working days and whenever precipitation is forecasted.
9. Provide sufficient separation between stored containers to allow for spill cleanup or emergency response access. Storage areas must be kept clean, well organized, and equipped with cleanup supplies appropriate for the materials being stored.
10. Repair or replace perimeter controls, containment structures, covers, and liners as necessary. Inspect storage areas before and after precipitation and at least weekly during other times.

## **Stockpile Management**

Minimize stockpiling of materials at the job site.

Implement water pollution control practices within 72 hours of stockpiling material or before a forecasted storm event, whichever occurs first. If stockpiles are being used, do not allow soil, sediment, or other debris to enter storm drains, open drainages, and watercourses.

Active and inactive soil stockpiles must be:

1. Covered with soil stabilization material or a temporary cover
2. Surrounded with a linear sediment barrier

Stockpiles of asphalt concrete and PCC rubble, HMA, aggregate base, or aggregate subbase must be:

1. Covered with a temporary cover
2. Surrounded with a linear sediment barrier

Stockpiles of pressure-treated wood must be:

1. Placed on pallets
2. Covered with impermeable material

Stockpiles of cold mix asphalt concrete must be:

1. Placed on an impervious surface
2. Covered with an impermeable material
3. Protected from stormwater run-on and runoff

Control wind erosion year round under Section 14-9.02, "Dust Control," of the Standard Specifications.

Repair or replace linear sediment barriers and covers as needed to keep them functioning properly. Whenever sediment accumulates to 1/3 of the linear sediment barrier height, remove the accumulated sediment.

## **Waste Management**

### **Solid Waste**

Do not allow litter, trash, or debris to accumulate anywhere on the job site, including storm drain grates, trash racks, and ditch lines. Pick up and remove litter, trash, and debris from the job site at least once a week. The WPC manager must monitor solid waste storage and disposal procedures on the job site.

If practicable, recycle nonhazardous job site waste and excess material. If recycling is not practicable, dispose of it under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way," of the Standard Specifications.

Furnish enough closed-lid dumpsters of sufficient size to contain the solid waste generated by work activities. When refuse reaches the fill line, empty the dumpsters. Dumpsters must be watertight. Do not wash out dumpsters at the job site. Furnish additional containers and pick up dumpsters more frequently during the demolition phase of construction.

Solid waste includes:

1. Brick
2. Mortar
3. Timber
4. Metal scraps
5. Sawdust
6. Pipe
7. Electrical cuttings
8. Nonhazardous equipment parts
9. Styrofoam and other packaging materials
10. Vegetative material and plant containers from highway planting
11. Litter and smoking material, including litter generated randomly by the public
12. Other trash and debris

Furnish and use trash receptacles in the job site yard, field trailers, and locations where workers gather for lunch and breaks.

### **Hazardous Waste and Contamination**

If hazardous waste is, or will be, generated on the job site, the WPC manager must be thoroughly familiar with proper hazardous waste handling and emergency procedures under 40 CFR § 262.34(d)(5)(iii) and must have successfully completed training under 22 CA Code of Regs § 66265.16.

The WPC manager must:

1. Oversee and enforce hazardous waste management practices
2. Inspect all hazardous waste storage areas daily, including all temporary containment facilities and satellite collection locations
3. Oversee all hazardous waste transportation activities on the job site

Submit a copy of uniform hazardous waste manifest forms to the Engineer within 24 hours of transporting hazardous waste.

Submit receiving landfill documentation of proper disposal to the Engineer within 5 business days of hazardous waste transport from the project.

### **Unanticipated Discovery of Asbestos and Hazardous Substances**

Upon discovery of asbestos or a hazardous substance, comply with Section 14-11.02, "Asbestos and Hazardous Substances," of the Standard Specifications.

### **Hazardous Waste Management Practices**

Handle, store, and dispose of hazardous waste under 22 CA Code of Regs Div 4.5.

Use the following storage procedures:

1. Store hazardous waste and potentially hazardous waste separately from nonhazardous waste at the job site.
2. For hazardous waste storage, use metal containers approved by the United States Department of Transportation for the transportation and temporary storage of hazardous waste.
3. Store hazardous waste in sealed, covered containers labeled with the contents and accumulation start date under 22 CA Code of Regs, Div 4.5. Labels must comply with the provisions of 22 CA Code of Regs, Div 4.5. § 66262.31 and § 66262.32. Immediately replace damaged or illegible labels.
4. Handle hazardous waste containers such that no spillage occurs.
5. Store hazardous waste away from storm drains, watercourses, moving vehicles, and equipment.
6. Furnish containers with adequate storage volume at convenient satellite locations for hazardous waste collection. Immediately move these containers to secure temporary containment facilities when no longer needed at the collection location or when full.
7. Store hazardous waste and potentially hazardous waste in secure temporary containment enclosures having secondary containment facilities impervious to the materials stored there for a minimum contact-time of 72 hours. Temporary containment enclosures must be located away from public access. Acceptable secure enclosures include a locked chain link fenced area or a lockable shipping container located within the project limits.
8. Design and construct secondary containment facilities with a capacity to contain precipitation from a 24-hour-long, 25-year storm; and 10 percent of the aggregate volume of all containers, or the entire volume of the largest container within the facility, whichever is greater.
9. Cover secondary containment facilities during non-working days and if a storm event is predicted. Secondary containment facilities must be adequately ventilated.
10. Keep secondary containment facility free of accumulated rainwater or spills. After a storm event, or in the event of spills or leaks, collect accumulated liquid and place into drums within 24 hours. Handle these liquids as hazardous waste unless testing determines them to be nonhazardous.
11. Do not store incompatible wastes, such as chlorine and ammonia, in the same secondary containment facility.
12. Provide sufficient separation between stored containers to allow for spill cleanup or emergency response access. Storage areas must be kept clean, well organized, and equipped with cleanup supplies appropriate for the wastes being stored.
13. Repair or replace perimeter controls, containment structures, covers, and liners as necessary. Inspect storage areas before and after a storm event, and at least weekly during other times.

Do not:

1. Overfill hazardous waste containers
2. Spill hazardous waste or potentially hazardous waste
3. Mix hazardous wastes
4. Allow hazardous waste or potentially hazardous waste to accumulate on the ground

Dispose of hazardous waste within 90 days of the start of generation. Use a hazardous waste manifest and a transporter registered with the DTSC and in compliance with the CA Highway Patrol Biennial Inspection of Terminals Program to transport hazardous waste to an appropriately permitted hazardous waste management facility.

#### **Dust Control for Hazardous Waste or Contamination**

Excavation, transportation, and handling of material containing hazardous waste or contamination must result in no visible dust migration. Have a water truck or tank on the job site at all times while clearing and grubbing and performing earthwork operations in work areas containing hazardous waste or contamination.

#### **Stockpiling of Hazardous Waste or Contamination**

Do not stockpile material containing hazardous waste or contamination unless ordered. Stockpiles of material containing hazardous waste or contamination must not be placed where affected by surface run-on or run-off. Cover stockpiles with 13 mils minimum thickness of plastic sheeting or 1 foot of nonhazardous material. Do not place stockpiles in environmentally sensitive areas. Stockpiled material must not enter storm drains, inlets, or waters of the State.

#### **Contractor-Generated Hazardous Waste**

You are the generator of hazardous waste generated as a result of materials you bring to the job site. Use hazardous waste management practices if you generate waste on the job site from the following substances:

1. Petroleum materials
2. Asphalt materials
3. Concrete curing compound
4. Pesticides
5. Acids
6. Paints
7. Stains
8. Solvents
9. Wood preservatives
10. Roofing tar
11. Road flares
12. Lime
13. Glues and adhesives
14. Materials classified as hazardous waste under 22 CA Code of Regs, Div 4.5

If hazardous waste constituent concentrations are unknown, use a laboratory certified by the ELAP under the California Department Of Public Health to analyze a minimum of 4 discrete representative samples of the waste to determine whether it is a hazardous waste and to determine safe and lawful methods for storage and disposal. Perform sampling and analysis in compliance with US EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) and under 22 CA Code of Regs, Div 4.5.

Use your US EPA Generator Identification Number and sign hazardous waste manifests for the hazardous waste you generate.

Identify contaminated soil resulting from spills or leaks by noticing discoloration, or differences in soil properties. Immediately notify the Engineer of spills or leaks. Clean up spills and leaks under the Engineer's direction and to the satisfaction of the Engineer. Soil with evidence of contamination must be sampled and analysis performed by a laboratory certified by ELAP.

If sampling and analysis of contaminated soil demonstrates that it is a hazardous waste, handle and dispose of the soil as hazardous waste. You are the generator of hazardous waste created as the result of spills or leaks for which you are responsible.

Prevent the flow of water, including ground water, from mixing with contaminated soil by using one or a combination of the following measures:

1. Berms
2. Cofferdams
3. Grout curtains
4. Freeze walls
5. Concrete seal course

If water mixes with contaminated soil and becomes contaminated, sample and analyze the water using a laboratory certified by the ELAP. If analysis results demonstrate that the water is a hazardous waste, manage and dispose of the water as hazardous waste.

#### **Department-Generated Hazardous Waste**

If the Department is the generator of hazardous waste during the work performed on this project, use hazardous waste management practices.

Labels must comply with the provisions of 22 CA Code of Regs § 66262.31 and § 66262.32. Mark labels with:

1. Date the hazardous waste is generated
2. The words "Hazardous Waste"
3. Composition and physical state of the hazardous waste (for example, asphalt grindings with thermoplastic or paint)
4. The word "Toxic"
5. Name, address, and telephone number of the Engineer
6. Contract number
7. Contractor or subcontractor name

Handle the containers such that no spillage occurs.

#### **Hazardous Waste Transport and Disposal**

Dispose of hazardous waste within California at a disposal site operating under a permit issued by the DTSC.

The Engineer will obtain the US EPA Generator Identification Number for hazardous waste disposal.

The Engineer will sign all hazardous waste manifests. Notify the Engineer 5 business days before the manifests are to be signed.

The Department will not consider you a generator of the hazardous waste and you will not be obligated for further cleanup, removal, or remedial action for such material if handled or disposed of under these specifications and the appropriate State and federal laws and regulations and county and municipal ordinances and regulations regarding hazardous waste.

#### **Paint Waste**

Clean water-based and oil-based paint from brushes or equipment within a contained area in a way that does not contaminate soil, receiving waters, or storm drain systems. Handle and dispose of the following as hazardous waste: paints, thinners, solvents, residues, and sludges that cannot be recycled or reused. When thoroughly dry, dispose of the following as solid waste: dry latex paint, paint cans, used brushes, rags, absorbent materials, and drop cloths.

#### **Concrete Waste**

Use practices to prevent the discharge of asphalt concrete, PCC, and HMA waste into storm drain systems and receiving waters.

Collect and dispose of asphalt concrete, PCC, and HMA waste generated at locations where:

1. Concrete material, including grout, is used
2. Concrete dust and debris result from demolition
3. Sawcutting, coring, grinding, grooving, or hydro-concrete demolition creates a residue or slurry
4. Concrete trucks or other concrete-coated equipment is cleaned at the job site

### **Sanitary and Septic Waste**

Do not bury or discharge wastewater from a sanitary or septic system within the highway. A sanitary facility discharging into a sanitary sewer system must be properly connected and free from leaks. Place a portable sanitary facility at least 50 feet away from storm drains, receiving waters, and flow lines.

Comply with local health agency provisions if using an on-site disposal system.

### **Liquid Waste**

Use practices that will prevent job-site liquid waste from entering storm drain systems and receiving waters. Liquid waste include the following:

1. Drilling slurries or fluids
2. Grease-free and oil-free wastewater and rinse water
3. Dredgings, including liquid waste from cleaning drainage systems
4. Liquid waste running off a surface, including wash or rinse water
5. Other nonstormwater liquids not covered by separate permits

Hold liquid waste in structurally sound, leak-proof containers, such as roll-off bins or portable tanks.

Liquid waste containers must be of sufficient quantity and volume to prevent overflow, spills, and leaks.

Store containers at least 50 feet from moving vehicles and equipment.

Remove and dispose of deposited solids from sediment traps unless the Engineer approves another method.

Liquid waste may require testing to determine hazardous material content before disposal.

Dispose of drilling fluids and residue.

If a location approved by the Engineer is available within the job site, fluids and residue exempt under 23 CA Code of Regs § 2511(g) may be dried by evaporation in a leak-proof container. Dispose of the remaining as solid waste.

### **Nonstormwater Management**

#### **Water Control and Conservation**

Manage water used for work activities in a way that will prevent erosion and the discharge of pollutants into storm drain systems and receiving waters. Obtain authorization before washing anything at the job site with water that could discharge into a storm drain system or receiving waters. Report discharges immediately.

Implement water conservation practices if water is used at the job site. Inspect irrigation areas. Adjust watering schedules to prevent erosion, excess watering, or runoff. Shut off the water source to broken lines, sprinklers, or valves and repair breaks within 24 hours. Reuse water from waterline flushing for landscape irrigation if practicable. Sweep and vacuum paved areas. Do not wash paved areas with water.

Direct runoff water, including water from water line repair, from the job site to areas where it can infiltrate into the ground. Do not allow runoff water to enter storm drain systems and receiving waters. Do not allow spilled water to escape filling areas for water trucks. Direct water from off-site sources around the job site if practicable. Minimize the contact of off-site water with job site water.

#### **Illegal Connection and Discharge Detection and Reporting**

Before starting work, inspect the job site and the job site's perimeter for evidence of illicit connections, illegal discharges, and dumping. After starting work, inspect the job site and perimeter on a daily schedule for illicit connections and illegal dumping and discharges.

Whenever illegal connections, discharges, or dumping are discovered, notify the Engineer immediately. Do not take further action unless ordered. Assume that unlabeled or unidentifiable material is hazardous.

Look for the following evidence of illicit connections, illegal discharges, and dumping:

1. Debris or trash piles
2. Staining or discoloration on pavement or soils
3. Pungent odors coming from drainage systems
4. Discoloration or oily sheen on water
5. Stains and residue in ditches, channels, or drain boxes
6. Abnormal water flow during dry weather
7. Excessive sediment deposits
8. Nonstandard drainage junction structures
9. Broken concrete or other disturbances at or near junction structures



### **Vehicle and Equipment Cleaning**

Limit vehicle and equipment cleaning or washing at the job site except what is necessary to control vehicle tracking or hazardous waste. Notify the Engineer before cleaning vehicles and equipment at the job site with soap, solvents, or steam. Contain and recycle or dispose of resulting waste under "Waste Management" of these special provisions, whichever is applicable. Do not use diesel to clean vehicles or equipment. Minimize the use of solvents.

Clean or wash vehicles and equipment in a structure equipped with disposal facilities. You may wash vehicles in an outside area if the area is:

1. Paved with asphalt concrete, HMA, or PCC
2. Surrounded by a containment berm
3. Equipped with a sump to collect and dispose of wash water

Use as little water as practicable whenever washing vehicles and equipment with water. Hoses must be equipped with a positive shutoff valve.

Discharge liquid from wash racks to a recycling system or to another system approved by the Engineer. Remove liquids and sediment as necessary.

### **Vehicle and Equipment Fueling and Maintenance**

If practicable, perform maintenance on vehicles and equipment off-site.

If fueling or maintenance must be done at the job site, assign a site or sites, and obtain authorization before using them. Minimize mobile fueling and maintenance activities. Fueling and maintenance activities must be performed on level ground in areas protected from stormwater run-on and runoff.

Use containment berms or dikes around fueling and maintenance areas. Keep adequate quantities of absorbent spill-cleanup material and spill kits in the fueling or maintenance area and on fueling trucks. Dispose of spill-cleanup material and kits immediately after use under "Waste Management" of these special provisions. Use drip pans or absorbent pads during fueling or maintenance.

Do not leave fueling or maintenance areas unattended during fueling and maintenance activities. Fueling nozzles must be equipped with an automatic shutoff control. Nozzles must be equipped with vapor-recovery fueling nozzles where required by the Air Quality Management District. Secure nozzles in an upright position when not in use. Do not top off fuel tanks.

Recycle or properly dispose of used batteries and tires under "Waste Management" of these special provisions.

If leaks cannot be repaired immediately, remove the vehicle or equipment from the job site.

### **Material and Equipment Used Over Water**

Place drip pans and absorbent pads under vehicles and equipment used over water. Keep an adequate supply of spill-cleanup material with vehicles and equipment. Place drip pans or plastic sheeting under vehicles and equipment on docks, barges, or other surfaces over water whenever vehicles or equipment will be idle for more than 1 hour.

Furnish watertight curbs or toe boards on barges, platforms, docks, or other surfaces over water to contain material, debris, and tools. Secure material to prevent spills or discharge into the water due to wind.

Report discharges to receiving waters immediately upon discovery. Submit a discharge notification to the Engineer.

### **Structure Removal Over or Adjacent to Water**

Do not allow demolished material to enter storm drain systems and receiving waters. Use covers and platforms approved by the Engineer to collect debris. Use attachments on equipment to catch debris during small demolition activities. Empty debris-catching devices daily.

### **Paving, Sealing, Sawcutting, Grooving, and Grinding Activities**

Prevent material from entering storm drain systems and receiving waters including:

1. Cementitious material
2. Asphaltic material
3. Aggregate or screenings
4. Sawcutting, grooving, and grinding residue
5. Pavement chunks
6. Shoulder backing
7. Methacrylate

## 8. Sandblasting residue

Cover drainage inlets and use linear sediment barriers to protect downhill receiving waters until paving, sealing, sawcutting, grooving, and grinding activities are completed and excess material has been removed. Cover drainage inlets and manholes during the application of seal coat, tack coat, slurry seal, or fog seal.

Whenever precipitation is forecasted, limit paving, sawcutting, and grinding to places where runoff can be captured.

Do not start seal coat, tack coat, slurry seal, or fog seal activities whenever precipitation is forecasted during the application and curing period. Do not excavate material from existing roadways during precipitation.

Use a vacuum to remove slurry immediately after slurry is produced. Do not allow the slurry to run onto lanes open to traffic or off the pavement.

Collect the residue from PCC grooving and grinding activities with a vacuum attachment on the grinding machine. Do not leave the residue on the pavement or allow the residue to flow across pavement.

You may stockpile material excavated from existing roadways under "Material Management" of these special provisions if approved by the Engineer.

Do not coat asphalt trucks and equipment with substances that contain soap, foaming agents, or toxic chemicals.

Park paving equipment over drip pans or plastic sheeting with absorbent material to catch drips if the paving equipment is not in use.

### **Thermoplastic Striping and Pavement Markers**

Do not preheat, transfer, or load thermoplastic within 50 feet of drainage inlets and receiving waters.

Do not unload, transfer, or load bituminous material for pavement markers within 50 feet of drainage inlets and receiving waters.

Collect and dispose of bituminous material from the roadway after removing markers under "Waste Management" of these special provisions.

### **Pile Driving**

Keep spill kits and cleanup materials at pile driving locations. Park pile driving equipment over drip pans, absorbent pads, or plastic sheeting with absorbent material. Protect pile driving equipment by parking on plywood and covering with plastic whenever precipitation is forecasted.

Store pile driving equipment on level ground and protect it from stormwater run-on when not in use. Use vegetable oil instead of hydraulic fluid if practicable.

### **Concrete Curing**

Do not overspray chemical curing compounds. Minimize the drift by spraying as close to the concrete as practicable. Do not allow runoff of curing compounds. Cover drainage inlets before applying the curing compound.

Minimize the use and discharge of water by using wet blankets or similar methods to maintain moisture when concrete is curing.

### **Concrete Finishing**

Collect and dispose of water and solid waste from high-pressure water blasting under "Waste Management" of these special provisions. Collect and dispose of sand and solid waste from sandblasting under "Waste Management" of these special provisions. Before sandblasting, cover drainage inlets within 50 feet of sandblasting. Minimize the drift of dust and blast material by keeping the nozzle close to the surface of the concrete. If the character of the blast residue is unknown, test it for hazardous materials and dispose of it properly.

Inspect containment structures for concrete finishing for damage before each day of use and before forecasted precipitation. Remove liquid and solid waste from containment structures after each work shift.

### **Sweeping**

Sweep by hand or mechanical methods, such as vacuuming. Do not use methods that use only mechanical kick brooms.

Sweep paved roads at construction entrance and exit locations and paved areas within the job site:

1. During clearing and grubbing activities
2. During earthwork activities
3. During trenching activities
4. During roadway structural-section activities
5. When vehicles are entering and leaving the job site

6. After soil-disturbing activities
7. After observing off-site tracking of material

Monitor paved areas and roadways within the project. Sweep within:

1. 1 hour whenever sediment or debris is observed during activities that require sweeping
2. 24 hours whenever sediment or debris is observed during activities that do not require sweeping

Remove collected material, including sediment, from paved shoulders, drain inlets, curbs and dikes, and other drainage areas. You may stockpile collected material at the job site under "Material Management" of these special provisions. If stockpiled, dispose of collected material at least once per week under "Waste Management" of these special provisions.

You may dispose of sediment within the job site collected during sweeping activities. Protect the disposal areas against erosion.

Keep dust to a minimum during street sweeping activities. Use water or a vacuum whenever dust generation is excessive or sediment pickup is ineffective.

Remove and dispose of trash collected during sweeping under "Waste Management" of these special provisions.

### **Dewatering**

Dewatering consists of discharging accumulated stormwater, groundwater, or surface water from excavations or temporary containment facilities.

Perform dewatering work as specified for the work items involved, such as temporary active treatment system or dewatering and discharge.

If dewatering and discharging activities are not specified under a work item and you perform dewatering activities:

1. Conduct dewatering activities under the Department's Field Guide for Construction Site Dewatering.
2. Ensure that any dewatering discharge does not cause erosion, scour, or sedimentary deposits that could impact natural bedding materials.
3. Discharge the water within the project limits. If the water cannot be discharged within project limits due to site constraints or contamination, dispose of the water as directed by the Engineer.
4. Do not discharge stormwater or nonstormwater that has an odor, discoloration other than sediment, an oily sheen, or foam on the surface. Notify the Engineer immediately upon discovering any such condition.

### **MEASUREMENT AND PAYMENT**

The contract lump sum price paid for construction site management includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in spill prevention and control, material management, waste management, nonstormwater management, and dewatering activities, including identifying, sampling, testing, handling, and disposing of hazardous waste resulting from your activities, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as ordered by the Engineer.

## **10-1.06 TEMPORARY CONCRETE WASHOUTS**

### **GENERAL**

#### **Summary**

This work includes the removal and disposal of concrete waste by furnishing, maintaining, and removing temporary concrete washouts. You may use any of the following systems for temporary concrete washouts:

1. Temporary concrete washout facility
2. Portable temporary concrete washout
3. Temporary concrete washout bin

The UCP must describe and include the use of temporary concrete washouts as a water pollution control practice for waste management and materials pollution control.

### **Submittals**

At least 5 business days before concrete activities start, submit:

1. Location of each concrete washout system to be used
2. Name and location of the off-site concrete waste disposal plant licensed to receive the solid concrete waste, liquid concrete waste, or both
3. Copy of the permit issued by the RWQCB for the off-site commercial disposal plant
4. Copy of the permit issued by the state or local agency having jurisdiction over the disposal plant if the disposal site is located outside of the State

Retain and submit records of disposed concrete waste.

Submit a certificate of compliance for:

1. Gravel-filled bag
2. Plastic liner

### **MATERIALS**

#### **General**

The sign for a concrete washout must comply with section 12-3.06B, "Portable Signs," of the Standard Specifications except the sign panel may be plywood. The sign panel must be at least 2' x 4' in size. The sign legend must read "Concrete Washout" in 6-inch high black letters on a white background.

#### **Temporary Concrete Washout Facility**

A temporary concrete washout facility must be constructed to be a watertight container with enough capacity to contain all liquid and concrete waste generated by washout activities without seepage or spills.

Stakes may be either wood or metal and must comply with one of the following:

1. Wood stakes must be:
  - 1.1. Untreated fir, redwood, cedar, or pine and cut from sound timber
  - 1.2. Straight and free of loose or unsound knots and other defects which would render stakes unfit for use
  - 1.3. Pointed on the end to be driven into the ground
  - 1.4. At least 2" x 2" x 48" in size
2. Metal stakes must be at least 0.5-inch diameter and 48 inches long. Tops of metal stakes must be bent at a 90-degree angle or capped with an orange or red plastic safety cap that fits snugly to the metal stake.

Straw bales must comply with Section 20-2.06, "Straw," of the Standard Specifications and be:

1. At least 14 inches wide, 18 inches high, 36 inches long, and weigh at least 50 pounds.
2. Composed entirely of vegetative matter, except for binding material.
3. Bound by wire, nylon, or polypropylene string. Do not use jute or cotton binding. Baling wire must be minimum 16 gauge. Nylon or polypropylene string must be approximately 0.08-inch in diameter with 80 pounds of breaking strength.

Gravel-filled bag fabric must comply with Section 88-1.05, "Water Pollution Control," of the Standard Specifications.

Gravel for gravel-filled bags must be:

1. 3/8 to 3/4 inch in diameter
2. Clean and free of clay balls, organic matter, and other deleterious materials

Gravel-filled bag must:

1. Be made of gravel-filled bag fabric.
2. Have inside dimensions from 24 to 32 inches long, and from 16 to 20 inches wide.
3. Have bound opening to retain gravel. Opening must be sewn with yarn, bound with wire, or secured with a closure device.

4. Weigh from 30 to 50 pounds when filled with gravel.

The plastic liner for a temporary concrete washout facility must be:

1. Single ply, new polyethylene sheeting, without seams or overlapping joints
2. At least 10 mils thick
3. Free of holes, punctures, tears, or other defects

#### **Portable Temporary Concrete Washout**

A portable temporary concrete washout must be a commercially available, watertight container with enough capacity to contain all liquid and concrete waste generated by washout activities without seepage or spills and be:

1. At least 55 gallons in capacity.
2. Labeled for exclusive use as a concrete waste and washout facility. Stencil "Concrete Waste Material" in 3-inch high black letters on white background where the top of stenciling is 12 inches from the top of the container.

#### **Temporary Concrete Washout Bin**

A temporary concrete washout bin must be a commercially available, watertight container with enough capacity to contain all liquid and concrete waste generated by washout activities without seepage or spills and be:

1. At least 5 cubic yards in capacity
2. Roll-off type with or without folding steel ramps
3. Labeled for exclusive use as a concrete waste and washout facility

#### **CONSTRUCTION**

Place temporary concrete washout at the job site:

1. Before concrete placement activities start
2. In the immediate area of concrete work where authorized
3. No closer than 50 feet from storm drain inlets, open drainage facilities, ESAs, and watercourses
4. Away from traffic or public access areas

Install a concrete washout sign adjacent to each concrete washout location.

Use concrete washout to collect:

1. Washout from concrete delivery trucks
2. Slurries containing PCC or HMA from sawcutting, coring, grinding, grooving, and hydro-concrete demolition
3. Concrete waste from mortar mixing stations

Do not fill a concrete washout higher than 6 inches below the upper rim.

Remove and dispose of concrete waste within 2 business days after a concrete washout becomes filled. Dispose of concrete waste material at the designated off-site concrete waste disposal plant.

Relocate a portable temporary concrete washout or bin as needed for concrete work.

The Department does not pay for relocating a portable temporary concrete washout or bin.

Secure a portable temporary concrete washout or bin to prevent spilling of concrete waste material whenever it is being relocated or transported within the job site. Whenever any spilled material is observed, clean up the spilled material and place it back into the concrete washout unit.

#### **PAYMENT**

The contract lump sum price paid for temporary concrete washout includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in the removal and disposal of concrete waste and furnishing, maintaining, and removing the temporary concrete washout, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

### 10-1.07 COOPERATION

It is anticipated that work by another contractor may be in progress adjacent to or within the limits of this project during progress of the work on this contract. The following table lists contracts anticipated to be in progress during this contract.

| Contract No.              | Co-Rte-PM   | Location   | Type of Work                          |
|---------------------------|---|--|---------------------------------------|
| 04-2356A4                 | SM-101-0.0/3.6,<br>SCL-101-52.3/52.6  | In San Mateo County and Santa Clara County on US-101 from Marsh Road to Embarcadero Road   | Replacement landscaping               |
| 04-4A9234                 | SM-82-4.8/19.3<br>SM 101-6.6/20.7   | In San Mateo County On Route 82 From Whipple Avenue In Redwood City To Route 380 In San Bruno, And At Various Locations On And Adjacent To Route 101 From Whipple Avenue In Redwood City To Route 380 In San Bruno | Install Traffic System Infrastructure |
| Permit No.<br>0411-NMC041 | SM-82-0/19.3,<br>SM-84-<br>24.54/28.14,<br>SM-101-3.55/20.7<br>SM-114-Var,<br>SM-109-0.25/1.8 | In San Mateo County On Route 82, 84, 101, 109, 114 at Various Locations  | Install Traffic System Infrastructure |

Comply with Section 7-1.14, "Cooperation," of the Standard Specifications.

### 10-1.08 PROGRESS SCHEDULE (CRITICAL PATH METHOD)

#### SUMMARY

Comply with Section 8-1.04, "Progress Schedule," of the Standard Specifications except you must use computer software to prepare the schedule.

You are responsible for assuring that all activity sequences are logical and that each schedule shows a coordinated plan for complete performance of the work.

#### DEFINITIONS

**contract completion date:** Current extended date for completion of the contract shown on the Weekly Statement of Working Days furnished by the Engineer as specified in Section 8-1.06, "Time of Completion," of the Standard Specifications.

**data date:** Day after the date through which a schedule is current. Everything occurring earlier than the data date is as-built and everything on or after the data date is planned.

**early completion time:** Difference in time between an early scheduled completion date and the contract completion date.

**float:** Difference between the earliest and latest allowable start or finish times for an activity.

**milestone:** Event activity that has zero duration and is typically used to represent the beginning or end of a certain stage of the project.

**narrative report:** Document submitted with each schedule that discusses topics related to project progress and scheduling.

**near critical path:** Chain of activities with total float exceeding that of the critical path but having no more than 10 working days of total float.

**State-owned float activity:** Activity documenting time saved on the critical path by actions of the State. It is the last activity prior to the scheduled completion date.

**time impact analysis:** Schedule and narrative report developed specifically to demonstrate what effect a proposed change or delay has on the current scheduled completion date.

**time-scaled network diagram:** Graphic depiction of a CPM schedule comprised of activity bars with relationships for each activity represented by arrows. The tail of each arrow connects to the activity bar for the predecessor and points to the successor.

**total float:** Amount of time that an activity or chain of activities can be delayed before extending the scheduled completion date.

## **GENERAL REQUIREMENTS**

Submit baseline, monthly updated, and final updated schedules, each consistent in all respects with the time and order of work requirements of the contract. Perform work in the sequence indicated on the current accepted schedule.

Each schedule must show:

1. Calculations using the critical path method to determine controlling activities.
2. Duration activities less than 20 working days.
3. At least 50 but not more than 500 activities, unless authorized. The number of activities must be sufficient to assure adequate planning of the project, to permit monitoring and evaluation of progress, and to do an analysis of time impacts.
4. Each required constraint. Constraints other than those required by the special provisions may be included only if authorized.
5. State-owned float as the predecessor activity to the scheduled completion date.
6. Activities with identification codes for responsibility, stage, work shifts, location, and contract pay item numbers.

You may show early completion time on any schedule provided that the requirements of the contract are met. Early completion time is considered a resource for your exclusive use. You may increase early completion time by improving production, reallocating resources to be more efficient, performing sequential activities concurrently, or by completing activities earlier than planned. You may also submit for approval a VECP as specified in Section 4-1.035B, "Value Engineering Change Proposal," of the Standard Specifications that will reduce time of construction.

You may show a scheduled completion date that is later than the contract completion date on an update schedule, after the baseline schedule is accepted. Provide an explanation for a late scheduled completion date in the narrative report that is included with the schedule.

State-owned float is considered a resource for the exclusive use of the State. The Engineer may accrue State-owned float by the early completion of review of any type of required submittal when it saves time on the critical path. Prepare a time impact analysis, when requested by the Engineer, to determine the effect of the action as specified in "Time Impact Analysis." The Engineer documents State-owned float by directing you to update the State-owned float activity on the next updated schedule. Include a log of the action on the State-owned float activity and include a discussion of the action in the narrative report. The Engineer may use State-owned float to mitigate past, present, or future State delays by offsetting potential time extensions for contract change orders.

The Engineer may adjust contract working days for ordered changes that affect the scheduled completion date as specified in Section 4-1.03, "Changes," of the Standard Specifications. Prepare a time impact analysis to determine the effect of the change as specified in "Time Impact Analysis" and include the impacts acceptable to the Engineer in the next updated schedule. Changes that do not affect the controlling operation on the critical path will not be considered as the basis for a time adjustment. Changes that do affect the controlling operation on the critical path will be considered by the Engineer in decreasing time or granting an extension of time for completion of the contract. Time extensions will only be granted if the total float is absorbed and the scheduled completion date is delayed 1 or more working days because of the ordered change.

The Engineer's review and acceptance of schedules does not waive any contract requirements and does not relieve you of any obligation or responsibility for submitting complete and accurate information. Correct rejected schedules and resubmit them within 7 days of notification by the Engineer, at which time a new review period of 7 days will begin.

Errors or omissions on schedules do not relieve you from finishing all work within the time limit specified for completion of the contract. If, after a schedule has been accepted by the Engineer, either you or the Engineer discover that any aspect of the schedule has an error or omission, you must correct it on the next updated schedule.

## **COMPUTER SOFTWARE**

Submit a description of your proposed schedule software for authorization. All software must be compatible with the current version of the Windows operating system in use by the Engineer. The schedule software must include the latest version of Oracle Primavera P6 Professional Project Management for Windows, or equivalent.

If schedule software equivalent to P6 is proposed, it must be capable of:

1. Generating files that can be imported into P6
2. Comparing 2 schedules and providing reports of changes in activity ID, activity description, constraints, calendar assignments, durations, and logic ties

## **NETWORK DIAGRAMS, REPORTS, AND DATA**

Include the following with each schedule submittal:

1. 2 sets of originally plotted, time-scaled network diagrams
2. 2 copies of a narrative report
3. 1 read-only compact disk or floppy diskette containing the schedule data

The time-scaled network diagrams must conform to the following:

1. Show a continuous flow of information from left to right
2. Be based on early start and early finish dates of activities
3. Clearly show the primary paths of criticality using graphical presentation
4. Be prepared on 34" x 44"
5. Include a title block and a timeline on each page

The narrative report must be organized in the following sequence with all applicable documents included:

1. Transmittal letter
2. Work completed during the period
3. Identification of unusual conditions or restrictions regarding labor, equipment or material; including multiple shifts, 6-day work weeks, specified overtime or work at times other than regular days or hours
4. Description of the current critical path
5. Changes to the critical path and scheduled completion date since the last schedule submittal
6. Description of problem areas
7. Current and anticipated delays:
  - 7.1. Cause of delay
  - 7.2. Impact of delay on other activities, milestones, and completion dates
  - 7.3. Corrective action and schedule adjustments to correct the delay
8. Pending items and status thereof:
  - 8.1. Permits
  - 8.2. Change orders
  - 8.3. Time adjustments
  - 8.4. Noncompliance notices
9. Reasons for an early or late scheduled completion date in comparison to the contract completion date

Schedule submittals will only be considered complete when all documents and data have been submitted as described above.

## **PRECONSTRUCTION SCHEDULING CONFERENCE**

Schedule a preconstruction scheduling conference with your project manager and the Engineer within 15 days after contract approval. The Engineer will conduct the meeting and review the requirements of this section with you.

Submit a general time-scaled logic diagram displaying the major activities and sequence of planned operations and be prepared to discuss the proposed work plan and schedule methodology that comply with the requirements of this section. If you propose deviations to the construction staging, then the general time-scaled logic diagram must also display the deviations and resulting time impacts. Be prepared to discuss the proposal.

At this meeting, also submit the alphanumeric coding structure and activity identification system for labeling work activities. To easily identify relationships, each activity description must indicate its associated scope or location of work by including such terms as quantity of material, type of work, bridge number, station to station location, side of highway (such as left, right, northbound, southbound), lane number, shoulder, ramp name, ramp line descriptor, or mainline.

The Engineer reviews the logic diagram, coding structure, and activity identification system, and provide any required baseline schedule changes to you for implementation.



## **BASELINE SCHEDULE**

Beginning the week following the preconstruction scheduling conference, meet with the Engineer weekly to discuss schedule development and resolve schedule issues until the baseline schedule is accepted.

Submit a baseline schedule within 20 days of contract approval. Allow 20 days for the Engineer's review after the baseline schedule and all support data are submitted.

The baseline schedule must include the entire scope of work and how you plan to complete all work contemplated. The baseline schedule must show the activities that define the critical path. Multiple critical paths and near-critical paths must be kept to a minimum. A total of not more than 50 percent of the baseline schedule activities must be critical or near critical, unless otherwise authorized.

The baseline schedule must not extend beyond the number of contract working days. The baseline schedule must have a data date of contract approval. If you start work before contract approval, the baseline schedule must have a data date of the 1st day you performed work at the job site.

If you submit an early completion baseline schedule that shows contract completion in less than 85 percent of the contract working days, the baseline schedule must be supplemented with resource allocations for every task activity and include time-scaled resource histograms. The resource allocations must be shown to a level of detail that facilitates report generation based on labor crafts and equipment classes for you and your subcontractors. Use average composite crews to display the labor loading of on-site construction activities. Optimize and level labor to reflect a reasonable plan for accomplishing the work of the contract and to assure that resources are not duplicated in concurrent activities. The time-scaled resource histograms must show labor crafts and equipment classes to be used. The Engineer may review the baseline schedule activity resource allocations using Means Productivity Standards or equivalent to determine if the schedule is practicable.

## **UPDATED SCHEDULE**

Submit an updated schedule and meet with the Engineer to review contract progress, on or before the 1st day of each month, beginning 1 month after the baseline schedule is accepted. Allow 15 days for the Engineer's review after the updated schedule and all support data are submitted, except that the review period will not start until the previous month's required schedule is accepted. Updated schedules that are not accepted or rejected within the review period are considered accepted by the Engineer.

The updated schedule must have a data date of the 21st day of the month or other date established by the Engineer. The updated schedule must show the status of work actually completed to date and the work yet to be performed as planned. Actual activity start dates, percent complete, and finish dates must be shown as applicable. Durations for work that has been completed must be shown on the updated schedule as the work actually occurred, including Engineer submittal review and your resubmittal times.

You may include modifications such as adding or deleting activities or changing activity constraints, durations, or logic that do not (1) alter the critical path(s) or near critical path(s) or (2) extend the scheduled completion date compared to that shown on the current accepted schedule. Justify in writing the reasons for any changes to planned work. If any proposed changes in planned work will result in (1) or (2) above, then submit a time impact analysis as specified in this section.

## **TIME IMPACT ANALYSIS**

Submit a written time impact analysis (TIA) with each request for adjustment of contract time, or when you or the Engineer consider that an approved or anticipated change may impact the critical path or contract progress.

The TIA must illustrate the impacts of each change or delay on the current scheduled completion date or internal milestone, as appropriate. The analysis must use the accepted schedule that has a data date closest to and before the event. If the Engineer determines that the accepted schedule used does not appropriately represent the conditions before the event, the accepted schedule must be updated to the day before the event being analyzed. The TIA must include an impact schedule developed from incorporating the event into the accepted schedule by adding or deleting activities, or by changing durations or logic of existing activities. If the impact schedule shows that incorporating the event modifies the critical path and scheduled completion date of the accepted schedule, the difference between scheduled completion dates of the two schedules must be equal to the adjustment of contract time. The Engineer may construct and use an appropriate project schedule or other recognized method to determine adjustments in contract time until you provide the TIA.

Submit 2 copies of your TIA within 20 days of receiving a written request for a TIA from the Engineer. Allow the Engineer 15 days after receipt to review the submitted TIA. All approved TIA schedule changes must be shown on the next updated schedule.

If a TIA you submit is rejected, meet with the Engineer to discuss and resolve issues related to the TIA. If clarification is still needed, you are allowed 15 days to submit a protest as specified in Section 5-1.011, "Protests,"

of the Standard Specifications. If agreement is not reached, you are allowed 5 days from the date you receive the Engineer's response to your protest to submit an Initial Potential Claim Record as specified in Section 5-1.146B, "Initial Potential Claim Record," of the Standard Specifications. Only show actual as-built work, not unapproved changes related to the TIA, in subsequent updated schedules. If agreement is reached at a later date, approved TIA schedule changes must be shown on the next updated schedule. The Engineer withholds remaining payment on the schedule bid item if a TIA is requested and not submitted within 20 days. The schedule item payment resumes on the next estimate after the requested TIA is submitted. No other contract payment is withheld regarding TIA submittals.

### **FINAL UPDATED SCHEDULE**

Submit a final update, as-built schedule with actual start and finish dates for the activities, within 30 days after completion of contract work. Provide a written certificate with this submittal signed by your project manager or an officer of the company stating, "To my knowledge and belief, the enclosed final update schedule reflects the actual start and finish dates of the actual activities for the project contained herein." An officer of the company may delegate in writing the authority to sign the certificate to a responsible manager.

### **PAYMENT**

Progress schedule (critical path method) will be paid for at a lump sum price. The contract lump sum price paid for progress schedule (critical path method) includes full compensation for furnishing all labor, material, tools, equipment, and incidentals, and for doing all the work involved in preparing, furnishing, and updating schedules, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Payments for the progress schedule (critical path method) bid item will be made progressively as follows:

1. A total of 25 percent of the item amount will be paid upon achieving all of the following:
  - 1.1. Completion of 5 percent of all contract item work.
  - 1.2. Acceptance of all schedules and approval of all TIAs required to the time when 5 percent of all contract item work is complete.
2. A total of 50 percent of the item amount will be paid upon completion of 25 percent of all contract item work and acceptance of all schedules and approval of all TIAs required to the time when 25 percent of all contract item work is complete.
3. A total of 75 percent of the item amount will be paid upon completion of 50 percent of all contract item work and acceptance of all schedules and approval of all TIAs required to the time when 50 percent of all contract item work is complete.
4. A total of 100 percent of the item amount will be paid upon completion of all contract item work, acceptance of all schedules and approval of all TIAs required to the time when all contract item work is complete, and submittal of the certified final update schedule.

If you fail to complete any of the work or provide any of the schedules required by this section, the Engineer makes an adjustment in compensation as specified in Section 4-1.03C, "Changes in Character of Work," of the Standard Specifications for the work not performed. Adjustments in compensation for schedules will not be made for any increased or decreased work ordered by the Engineer in submitting schedules.

### **10-1.09 TIME-RELATED OVERHEAD**

The Contractor will be compensated for time-related overhead as described below and in conformance with "Force Account Payment" of these special provisions. The Contractor will not be compensated for time-related overhead for delays to the controlling operations caused by the Engineer that occur prior to the first working day, but will be compensated for actual overhead costs incurred, as determined by an independent Certified Public Accountant audit examination and report.

Attention is directed to "Beginning of Work, Time of Completion and Liquidated Damages," "Force Account Payment," and "Progress Schedule (Critical Path Method)" of these special provisions.

The provisions in Section 9-1.08D(2)(b), "Overhead Claims," of the Standard Specifications shall not apply.

Time-related overhead shall consist of those overhead costs, including field and home office overhead, that are in proportion to the time required to complete the work. Time-related overhead shall not include costs that are not related to time, including but not limited to, mobilization, licenses, permits, and other charges incurred only once during the contract. Time-related overhead shall not apply to subcontractors of any tier, suppliers, fabricators, manufacturers, or other parties associated with the Contractor.

Field office overhead expenses include time-related costs associated with the normal and recurring operations of the construction project, and shall not include costs directly attributable to the work of the contract. Time-related costs of field office overhead include, but are not limited to, salaries, benefits, and equipment costs of project managers, general superintendents, field office managers and other field office staff assigned to the project, and rent, utilities, maintenance, security, supplies, and equipment costs of the project field office.

Home office overhead or general and administrative expenses refer to the fixed costs of operating the Contractor's business. These costs include, but are not limited to, general administration, insurance, personnel and subcontract administration, purchasing, accounting, and project engineering and estimating. Home office overhead costs shall exclude expenses specifically related to other contracts or other businesses of the Contractor, equipment coordination, material deliveries, and consultant and legal fees.

The quantity of time-related overhead associated with a reduction in contract time for an accepted VECP under Section 4-1.035B, "Value Engineering Change Proposal," of the Standard Specifications shall be considered a construction cost attributable to the resultant estimated net savings due to the cost reduction incentive.

If the final increased quantity of time-related overhead exceeds 149 percent of the number of working days specified in the verified Bid Item List, the Contractor shall, within 60 days of the Engineer's written request, submit to the Engineer an audit examination and report performed by an independent Certified Public Accountant of the Contractor's actual overhead costs. The audit examination and report shall depict the Contractor's project and company-wide financial records and shall specify the actual overall average daily rates for both field and home office overhead for the entire duration of the project, and whether the costs have been properly allocated. The rates of field and home office overhead shall exclude unallowable costs as determined in the Federal Acquisition Regulations, 48 CFR, Chapter 1, Part 31.

Independent Certified Public Accountant's audit examinations shall be performed in conformance with the requirements of the American Institute of Certified Public Accountants Attestation Standards. Audit examinations and reports shall determine if the rates of field office overhead and home office overhead are:

- A. Allowable in conformance with the requirements of the Federal Acquisition Regulations, 48 CFR, Chapter 1, Part 31.
- B. Adequately supported by reliable documentation.
- C. Related solely to the project under examination.

Within 20 days of receipt of the Engineer's written request, the Contractor shall make its financial records available for audit by the State for the purpose of verifying the actual rate of time-related overhead specified in the audit submitted by the Contractor. The actual rate of time-related overhead specified in the audit, submitted by the Contractor, will be subject to approval by the Engineer.

If the Engineer requests the independent Certified Public Accountant audit, or if it is requested in writing by the Contractor, the contract item payment rate for time-related overhead, in excess of 149 percent of the number of working days specified in the verified Bid Item List, will be adjusted to reflect the actual rate.

The cost of performing an independent Certified Public Accountant audit examination and submitting the report, requested by the Engineer, will be borne equally by the State and the Contractor. The division of the cost will be made by determining the cost of providing an audit examination and report in conformance with the provisions of Section 9-1.04, "Extra Work Performed by Specialists," of the Standard Specifications, and paying to the Contractor one-half of that cost. The cost of performing an audit examination and submitting the independent Certified Public Accountant audit report for overhead claims other than for the purpose of verifying the actual rate of time-related overhead shall be entirely borne by the Contractor. The cost of performing an audit examination and submitting the independent Certified Public Accountant audit report to verify actual overhead costs incurred prior to the first working day shall be entirely borne by the Contractor.

The quantity of time-related overhead to be paid will be measured by the working day, designated in the verified Bid Item List as WDAY. The estimated number of working days is the number of working days, excluding days for plant establishment, as specified in "Beginning of Work, Time of Completion and Liquidated Damages" of these special provisions. The quantity of time-related overhead will be increased or decreased only as a result of suspensions or adjustments of contract time which revise the current contract completion date, and which satisfy any of the following criteria:

- A. Suspensions of work ordered in conformance with the provisions in Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications, except:
  - 1. Suspensions ordered due to weather conditions being unfavorable for the suitable prosecution of the controlling operation or operations.

2. Suspensions ordered due to the failure on the part of the Contractor to carry out orders given, or to perform the provisions of the contract.
  3. Suspensions ordered due to factors beyond the control of and not caused by the State or the Contractor, for which the Contractor is granted non-working days.
  4. Other suspensions that mutually benefit the State and the Contractor.
- B. Adjustments of contract time granted by the State set forth in approved contract change orders, in conformance with the provisions in Section 4-1.03, "Changes," of the Standard Specifications.

A delay to the controlling operation may be concurrent and any of the following:

1. Nonexcusable: A nonexcusable delay is caused by the fault, nonperformance, or deficiency of the Contractor, subcontractors of any tier, or suppliers. The days during a nonexcusable delay are working days. No time or payment adjustment for a nonexcusable delay is allowed.
2. Excusable: An excusable delay is caused by factors beyond the control and without the fault of the State or the Contractor. The days during an excusable delay are non-working days.
3. Compensable: A compensable delay is caused solely by the fault, deficiency, error, omission, or change made by the State. A time adjustment and a payment adjustment for the actual cost without markup or profit are allowed.

A concurrent delay occurs when 2 or more separate delays overlap partially or entirely. A nonexcusable delay concurrent with either an excusable or a compensable delay is a nonexcusable delay. An excusable delay concurrent with a compensable delay is an excusable delay.

The quantity of time-related overhead is only adjusted as a result of a compensable delay and is not adjusted as a result of either a nonexcusable or an excusable delay.

An approved time impact analysis submitted as specified in "Progress Schedule (Critical Path Method)" of these special provisions is used to determine the type and duration of a delay.

In the event an early completion progress schedule, as defined in "Progress Schedule (Critical Path Method)" of these special provisions, is submitted by the Contractor and approved by the Engineer, the amount of time-related overhead eligible for payment will be based on the total number of working days for the project, in conformance with the provisions in "Beginning of Work, Time of Completion and Liquidated Damages" of these special provisions, rather than the Contractor's early completion progress schedule.

The contract price paid per working day for time-related overhead shall include full compensation for time-related overhead, including the Contractor's share of costs of the independent Certified Public Accountant audit of overhead costs requested by the Engineer, as specified in these special provisions, and as directed by the Engineer.

The provisions in Sections 4-1.03B, "Increased or Decreased Quantities," and 4-1.03C, "Changes in Character of the Work," of the Standard Specifications shall not apply to the contract item of time-related overhead.

Full compensation for additional overhead costs incurred during days of inclement weather when the contract work is extended into additional construction seasons due to delays caused by the State shall be considered as included in the time-related overhead paid during the contract working days, and no additional compensation will be allowed therefor.

Full compensation for additional overhead costs involved in performing additional contract item work that is not a controlling operation shall be considered as included in the contract items of work involved and no additional compensation will be allowed therefor.

Full compensation for overhead, other than time-related overhead measured and paid for as specified above, and other than overhead costs included in the markups specified in "Force Account Payment" of these special provisions, shall be considered as included in the various items of work and no additional compensation will be allowed therefor.

Overhead costs incurred by subcontractors of any tier, suppliers, fabricators, manufacturers, and other parties associated with the Contractor shall be considered as included in the various items of work and as specified in Section 9-1.03, "Force Account Payment," of the Standard Specifications.

For the purpose of making progress payments pursuant to the provisions in Section 9-1.07, "Progress Payments," of the Standard Specifications, the number of working days to be paid for time-related overhead in each monthly partial payment will be the number of working days, specified above to be measured for payment that occurred during that monthly estimate period, including compensable suspensions and right of way delays. Working days granted by contract change order due to extra work or changes in character of the work, will be paid for upon completion of the contract. The amount earned per working day for time-related overhead shall be the lesser of the following amounts:

- A. The contract item price.
- B. Twenty percent of the original total contract amount divided by the number of working days specified in "Beginning of Work, Time of Completion and Liquidated Damages," of these special provisions.

After acceptance of the contract in conformance with the provisions in Section 7-1.17, "Acceptance of Contract," of the Standard Specifications, the amount of the total contract item price for time-related overhead not yet paid, will be included for payment in the first estimate made after acceptance of the contract in conformance with the provisions in Section 9-1.08, "Payment After Contract Acceptance," of the Standard Specifications.

#### **10-1.10 CONSTRUCTION AREA TRAFFIC CONTROL DEVICES**

Flagging, signs, and temporary traffic control devices furnished, installed, maintained, and removed when no longer required shall conform to the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Category 1 temporary traffic control devices are defined as small and lightweight (less than 100 pounds) devices. These devices shall be certified as crashworthy by crash testing, crash testing of similar devices, or years of demonstrable safe performance. Category 1 temporary traffic control devices include traffic cones, plastic drums, portable delineators, and channelizers.

If requested by the Engineer, the Contractor shall provide written self-certification for crashworthiness of Category 1 temporary traffic control devices at least 5 business days before beginning any work using the devices or within 2 business days after the request if the devices are already in use. Self-certification shall be provided by the manufacturer or Contractor and shall include the following:

- A. Date,
- B. Federal Aid number (if applicable),
- C. Contract number, district, county, route and post mile of project limits,
- D. Company name of certifying vendor, street address, city, state and zip code,
- E. Printed name, signature and title of certifying person; and
- F. Category 1 temporary traffic control devices that will be used on the project.

The Contractor may obtain a standard form for self-certification from the Engineer.

Category 2 temporary traffic control devices are defined as small and lightweight (less than 100 pounds) devices that are not expected to produce significant vehicular velocity change, but may cause potential harm to impacting vehicles. Category 2 temporary traffic control devices include barricades and portable sign supports.

Category 2 temporary traffic control devices shall be on the Federal Highway Administration's (FHWA) list of Acceptable Crashworthy Category 2 Hardware for Work Zones. This list is maintained by FHWA and can be located at:

[http://safety.fhwa.dot.gov/roadway\\_dept/policy\\_guide/road\\_hardware/listing.cfm?code=workzone](http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/listing.cfm?code=workzone)

The Department also maintains this list at:

<http://www.dot.ca.gov/hq/traffops/signtech/signdel/pdf/Category2.pdf>

Category 2 temporary traffic control devices that have not received FHWA acceptance shall not be used. Category 2 temporary traffic control devices in use that have received FHWA acceptance shall be labeled with the FHWA acceptance letter number and the name of the manufacturer. The label shall be readable and permanently affixed by the manufacturer. Category 2 temporary traffic control devices without a label shall not be used.

If requested by the Engineer, the Contractor shall provide a written list of Category 2 temporary traffic control devices to be used on the project at least 5 business days before beginning any work using the devices or within 2 business days after the request if the devices are already in use.

Category 3 temporary traffic control devices consist of temporary traffic-handling equipment and devices that weigh 100 pounds or more and are expected to produce significant vehicular velocity change to impacting vehicles. Temporary traffic-handling equipment and devices include crash cushions, truck-mounted attenuators, temporary railing, temporary barrier, and end treatments for temporary railing and barrier.

Type III barricades may be used as sign supports if the barricades have been successfully crash tested, meeting the NCHRP Report 350 criteria, as one unit with a construction area sign attached.

Category 3 temporary traffic control devices shall be shown on the plans or on the Department's Highway Safety Features list. This list is maintained by the Division of Engineering Services and can be found at:

[http://www.dot.ca.gov/hq/esc/approved\\_products\\_list/](http://www.dot.ca.gov/hq/esc/approved_products_list/)

Category 3 temporary traffic control devices that are not shown on the plans or not listed on the Department's Highway Safety Features list shall not be used.

Full compensation for providing self-certification for crashworthiness of Category 1 temporary traffic control devices and for providing a list of Category 2 temporary traffic control devices used on the project shall be considered as included in the prices paid for the various items of work requiring the use of the Category 1 or Category 2 temporary traffic control devices and no additional compensation will be allowed therefor.

#### **10-1.11 CONSTRUCTION AREA SIGNS**

Construction area signs for temporary traffic control shall be furnished, installed, maintained, and removed when no longer required in conformance with the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Attention is directed to "Furnish Sign" of these special provisions.

Attention is directed to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions. Type II retroreflective sheeting shall not be used on construction area sign panels. Type III, IV, VII, VIII, or IX retroreflective sheeting shall be used for stationary mounted construction area sign panels.

Unless otherwise shown on the plans or specified in these special provisions, the color of construction area warning and guide signs shall have black legend and border on orange background, except W10-1 or W47(CA) (Highway-Rail Grade Crossing Advance Warning) sign shall have black legend and border on yellow background.

Orange background on construction area signs shall be fluorescent orange.

Repair to construction area sign panels will not be allowed, except when approved by the Engineer. At nighttime under vehicular headlight illumination, sign panels that exhibit irregular luminance, shadowing or dark blotches shall be immediately replaced at the Contractor's expense.

The Contractor shall notify the appropriate regional notification center for operators of subsurface installations at least 2 business days, but not more than 14 days, prior to commencing excavation for construction area sign posts. The regional notification centers include, but are not limited to, the following:

| Notification Center       | Telephone Number |
|---------------------------|------------------|
| Underground Service Alert | 811              |

Excavations required to install construction area signs shall be performed by hand methods without the use of power equipment, except that power equipment may be used if it is determined there are no utility facilities in the area of the proposed post holes. The post hole diameter, if backfilled with portland cement concrete, shall be at least 4 inches greater than the longer dimension of the post cross section.

Construction area signs placed within 15 feet from the edge of the travel way shall be mounted on stationary mounted sign supports as specified in "Construction Area Traffic Control Devices" of these special provisions.

The Contractor shall maintain accurate information on construction area signs. Signs that are no longer required shall be immediately covered or removed. Signs that convey inaccurate information shall be immediately replaced or the information shall be corrected. Covers shall be replaced when they no longer cover the signs properly. The Contractor shall immediately restore to the original position and location any sign that is displaced or overturned, from any cause, during the progress of work.

#### **10-1.12 MAINTAINING TRAFFIC**

Maintaining traffic shall conform to the provisions in Section 7-1.08, "Public Convenience," Section 7-1.09, "Public Safety," and Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Closure is defined as the closure of a traffic lane or lanes, including shoulder, ramp or connector lanes, within a single traffic control system.

Closures shall conform to the provisions in "Traffic Control System for Lane Closure" of these special provisions.

Work that interferes with public traffic shall be limited to the hours when lane closures are allowed, except for work required under Section 7-1.08, "Public Convenience," and Section 7-1.09, "Public Safety."

Designated legal holidays are: January 1st, the third Monday in February, the last Monday in May, July 4th, the first Monday in September, November 11th, Thanksgiving Day, and December 25th. When a designated legal

holiday falls on a Sunday, the following Monday shall be a designated legal holiday. When November 11th falls on a Saturday, the preceding Friday shall be a designated legal holiday.

Special days are: the third Monday in January.

Under one-way reversing traffic control operations, public traffic may be stopped in one direction for periods not to exceed 5 minutes. After each stoppage, all accumulated traffic for that direction shall pass through the work zone before another stoppage is made.

The maximum length of a single stationary lane closure shall be 0.25 miles.

Not more than 2 separate stationary lane closures will be allowed in each direction of travel at one time. Concurrent stationary closures shall be spaced no closer than 2 miles apart.

Local authorities shall be notified at least 5 business days before work begins. The Contractor shall cooperate with local authorities to handle traffic through the work area and shall make arrangements to keep the work area clear of parked vehicles.

No work on local streets is allowed between 6:00 a.m. and 8:00 p.m.

Adjacent local streets shall not be closed simultaneously unless directed by the Engineer.

Ramps adjacent to the closed freeway lane may be closed.

Adjacent ramps, in the same direction of travel, servicing 2 consecutive local streets shall not be closed simultaneously unless directed by the Engineer.

SC6-3(CA) (RAMP CLOSED) sign shall be used to inform motorists of the temporary closing of a connector, entrance ramp or exit ramp for 1 business day.

SC6-4(CA) (RAMP CLOSED) sign shall be used to inform motorists of the temporary closing of a connector, entrance ramp or exit ramp for more than 1 business day.

The SC6-3(CA) or SC6-4(CA) signs shall be installed at least 7 days before closing the connector or ramp, but not more than 15 days before the connector or ramp closure. The Contractor shall notify the Engineer at least 2 business days before installing the SC6-3(CA) or SC6-4(CA) signs.

Accurate information shall be maintained on the SC6-3(CA) or SC6-4(CA) signs. The SC6-3(CA) or SC6-4(CA) signs, when no longer required, shall be immediately covered or removed.

Personal vehicles of the Contractor's employees shall not be parked on the traveled way or shoulders including sections closed to public traffic.

When work vehicles or equipment are parked within 6 feet of a traffic lane to perform active construction, the shoulder area shall be closed as shown on the plans.

If minor deviations from the lane requirement charts are required, a written request shall be submitted to the Engineer at least 15 days before the proposed date of the closure. The Engineer may approve the deviations if there is no significant increase in the cost to the State and if the work can be expedited and better serve the public traffic.

Full compensation for furnishing, erecting, maintaining, and removing and disposing of the SC6-3(CA) and SC6-4(CA) signs shall be considered as included in the contract lump sum price paid for construction area signs and no additional compensation will be allowed therefor.

| Lane Closure Restriction for Designated Legal Holidays and Special Days |   |                 |                 |                 |                 |                 |                 |     |     |     |
|---|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----|-----|-----|
| Thu   | Fri   | Sat             | Sun             | Mon             | Tues            | Wed             | Thu             | Fri | Sat | Sun |
| x   | <b>H</b><br>xx  | xx              | xx              |                 |                 |                 |                 |     |     |     |
|   | <b>SD</b><br>xx   |                 |                 |                 |                 |                 |                 |     |     |     |
| x   | xx  | <b>H</b><br>xx  | xx              |                 |                 |                 |                 |     |     |     |
|   |   | <b>SD</b><br>xx |                 |                 |                 |                 |                 |     |     |     |
|   | x   | xx              | <b>H</b><br>xx  | xx              |                 |                 |                 |     |     |     |
|   |   |                 | <b>SD</b><br>xx |                 |                 |                 |                 |     |     |     |
|   | x   | xx              | xx              | <b>H</b><br>xx  | xxx             |                 |                 |     |     |     |
|   | x   | xx              | xx              | <b>SD</b><br>xx | xxx             |                 |                 |     |     |     |
|   |   |                 |                 | x               | <b>H</b><br>xx  |                 |                 |     |     |     |
|   |   |                 |                 | x               | <b>SD</b><br>xx |                 |                 |     |     |     |
|   |   |                 |                 |                 | x               | <b>H</b><br>xx  |                 |     |     |     |
|   |   |                 |                 |                 |                 | <b>SD</b><br>xx |                 |     |     |     |
|   |   |                 |                 |                 |                 | x               | <b>H</b><br>xx  | xx  | xx  | xx  |
|   |   |                 |                 |                 |                 |                 | <b>SD</b><br>xx |     |     |     |
| Legends:  |   |                 |                 |                 |                 |                 |                 |     |     |     |
|   | Refer to lane closure charts  |                 |                 |                 |                 |                 |                 |     |     |     |
| x   | The full width of the traveled way shall be open for use by public traffic after 6 a.m.     |                 |                 |                 |                 |                 |                 |     |     |     |
| xx  | The full width of the traveled way shall be open for use by public traffic.                 |                 |                 |                 |                 |                 |                 |     |     |     |
| xxx   | The full width of the traveled way shall be open for use by public traffic until 11:59 p.m. |                 |                 |                 |                 |                 |                 |     |     |     |
| <b>H</b>  | Designated Legal Holiday  |                 |                 |                 |                 |                 |                 |     |     |     |
| <b>SD</b>   | Special Day   |                 |                 |                 |                 |                 |                 |     |     |     |

Pedestrian access facilities shall be provided through construction areas within the right of way as shown on the plans and as specified herein. Pedestrian walkways shall be surfaced with hot mix asphalt, portland cement concrete or timber. The surface shall be skid resistant and free of irregularities. Hand railings shall be provided on each side of pedestrian walkways as necessary to protect pedestrian traffic from hazards due to construction operations or adjacent vehicular traffic. Protective overhead covering shall be provided as necessary to insure protection from falling objects and drip from overhead structures.

In addition to the required openings through falsework, pedestrian facilities shall be provided during pile driving, footing, wall, and other bridge construction operations. At least one walkway shall be available at all times. If the Contractor's operations require the closure of one walkway, then another walkway shall be provided nearby, off the traveled roadway.

Railings shall be constructed of wood, S4S, and shall be painted white. Railings and walkways shall be maintained in good condition. Walkways shall be kept clear of obstructions.

Full compensation for providing pedestrian facilities shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.



| <b>Chart No. 1</b>   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
|--|--|----|---|---|---|---|---|------------------------|---|---|---|----|----|----|----|----------------|----|----|----|----|----|----|----|----|----|----|--|
| <b>Freeway/Expressway Lane Requirements</b>  |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
| County: SM   |  |    |   |   |   |   |   | Route/Direction: 84/NB |   |   |   |    |    |    |    | PM: 25.7/28.91 |    |    |    |    |    |    |    |    |    |    |  |
| Closure Limits: From Marsh Rd I/S to University Ave. I/S   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR  |  | 24 | 1 | 2 | 3 | 4 | 5 | 6                      | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14             | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays  |  | 1  | 1 | 1 | 1 | 1 | 1 | 2                      | S | S | S | S  | S  | S  | S  |                |    |    |    |    |    |    | S  | 2  | 2  |    |  |
| Fridays  |  | 1  | 1 | 1 | 1 | 1 | 1 | 2                      | S | S | S | S  | S  | S  | S  |                |    |    |    |    |    |    | S  | S  | 2  |    |  |
| Saturdays  |  | 2  | 1 | 1 | 1 | 1 | 1 | 1                      | 2 | 2 | 2 | S  | S  | S  | S  |                |    |    |    |    | S  | S  | S  | S  | 2  |    |  |
| Sundays  |  | 2  | 1 | 1 | 1 | 1 | 1 | 1                      | 1 | 1 | 2 | 2  | S  | S  | S  | S              | S  | S  | S  | S  | 2  | 2  | 2  | 2  | 1  |    |  |
| <p>Legend:</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">1</div> Provide at least one through freeway lane open in direction of travel. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">2</div> Provide at least two adjacent through freeway lanes open in direction of travel. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">S</div> Shoulder closure permitted. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
| REMARKS:   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |

| <b>Chart No. 2</b>   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
|--|--|----|---|---|---|---|---|------------------------|---|---|---|----|----|----|----|----------------|----|----|----|----|----|----|----|----|----|----|--|
| <b>Freeway/Expressway Lane Requirements</b>  |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
| County: SM   |  |    |   |   |   |   |   | Route/Direction: 84/SB |   |   |   |    |    |    |    | PM: 25.7/28.91 |    |    |    |    |    |    |    |    |    |    |  |
| Closure Limits: From Marsh Rd I/S to University Ave. I/S   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR  |  | 24 | 1 | 2 | 3 | 4 | 5 | 6                      | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14             | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays  |  | 1  | 1 | 1 | 1 | 1 | S |                        |   |   |   |    | S  | S  | S  | S              | S  | S  | S  | S  | 2  | 2  | 2  | 1  | 1  |    |  |
| Fridays  |  | 1  | 1 | 1 | 1 | 1 | S |                        |   |   |   |    | S  | S  | S  | S              | S  | S  | S  | S  | 2  | 2  | 2  | 2  | 1  |    |  |
| Saturdays  |  | 1  | 1 | 1 | 1 | 1 | 1 | 2                      | S | S | S | S  | S  | S  |    |                |    |    |    | S  | S  | 2  | 2  | 2  | 2  |    |  |
| Sundays  |  | 1  | 1 | 1 | 1 | 1 | 1 | 1                      | 1 | 2 | 2 | S  | S  | S  | S  | S              | S  | S  | S  | 2  | 2  | 2  | 1  | 1  |    |    |  |
| <p>Legend:</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">1</div> Provide at least one through freeway lane open in direction of travel. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">2</div> Provide at least two adjacent through freeway lanes open in direction of travel. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">S</div> Shoulder closure permitted. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
| REMARKS:   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |

| <b>Chart No. 3</b>   |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |  |
|--|--|----|---|---|---|---|---|-------------------------|---|---|---|----|----|----|----|--------------|----|----|----|----|----|----|----|----|----|----|--|
| <b>Freeway/Expressway Lane Requirements</b>  |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |  |
| County: SM   |  |    |   |   |   |   |   | Route/Direction: 101/NB |   |   |   |    |    |    |    | PM: 0.86/5.7 |    |    |    |    |    |    |    |    |    |    |  |
| Closure Limits: From University Ave. I/C to Jct. Route 84/Woodside Rd I/C  |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR  |  | 24 | 1 | 2 | 3 | 4 | 5 | 6                       | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14           | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays  |  | S  | S | S | S | S |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    |    | S  | S  | S  | S  |  |
| Fridays  |  | S  | S | S | S | S |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    |    | S  | S  | S  | S  |  |
| Saturdays  |  | S  | S | S | S | S | S | S                       | S | S | S | S  |    |    |    |              |    |    |    |    |    | S  | S  | S  | S  | S  |  |
| Sundays  |  | S  | S | S | S | S | S | S                       | S | S | S | S  | S  | S  | S  |              |    |    |    | S  | S  | S  | S  | S  | S  | S  |  |
| <p>Legend:</p> <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px;"></div> S Shoulder closure permitted (right). <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px; margin-top: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |  |
| REMARKS:   |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |  |

| <b>Chart No. 4</b>   |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |  |
|--|--|----|---|---|---|---|---|-------------------------|---|---|---|----|----|----|----|--------------|----|----|----|----|----|----|----|----|----|----|--|
| <b>Freeway Lane Requirements</b>   |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |  |
| County: SM   |  |    |   |   |   |   |   | Route/Direction: 101/SB |   |   |   |    |    |    |    | PM: 0.86/5.7 |    |    |    |    |    |    |    |    |    |    |  |
| Closure Limits: From University Ave I/C to Jct. Route 84/Woodside Rd I/C   |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR  |  | 24 | 1 | 2 | 3 | 4 | 5 | 6                       | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14           | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays  |  | 4  | 4 | 4 | 4 | 4 |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    | 4  | 4  | 4  | 4  | 4  |  |
| Fridays  |  | 4  | 4 | 4 | 4 | 4 |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    | 4  | 4  | 4  | 4  | 4  |  |
| Saturdays  |  | 4  | 4 | 4 | 4 | 4 | 4 | 4                       | 4 | 4 | 4 |    |    |    |    |              |    |    |    |    |    | 4  | 4  | 4  | 4  | 4  |  |
| Sundays  |  | 4  | 4 | 4 | 4 | 4 | 4 | 4                       | 4 | 4 | 4 | 4  | 4  |    |    |              |    |    |    | 4  | 4  | 4  | 4  | 4  | 4  | 4  |  |
| <p>Legend:</p> <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px;"></div> 4 Provide at least four adjacent through freeway lanes open in direction of travel. <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px; margin-top: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |  |
| REMARKS:   |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |  |

| Chart No. 5<br>Complete Connector Closure Hours                         |  |  |   |   |   |   |   |                        |   |   |   |    |    |    |    |    |    |           |    |    |    |    |    |    |    |    |  |
|---|--|--|---|---|---|---|---|------------------------|---|---|---|----|----|----|----|----|----|-----------|----|----|----|----|----|----|----|----|--|
| County: SM  |  |  |   |   |   |   |   | Route/Direction: 84/NB |   |   |   |    |    |    |    |    |    | PM: 24.77 |    |    |    |    |    |    |    |    |  |
| Closure Limits: On the Connector Off-ramp to NB Route 82/El Camino Real |  |  |   |   |   |   |   |                        |   |   |   |    |    |    |    |    |    |           |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR   |  | 24   | 1 | 2 | 3 | 4 | 5 | 6                      | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16        | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays   |  | C  | C | C | C | C | C | C                      |   |   |   |    |    |    |    |    |    |           |    |    |    | C  | C  | C  | C  |    |  |
| Fridays   |  | C  | C | C | C | C | C | C                      |   |   |   |    |    |    |    |    |    |           |    |    |    | C  | C  | C  | C  |    |  |
| Saturdays   |  | C  | C | C | C | C | C | C                      | C | C | C |    |    |    |    |    |    |           |    |    |    | C  | C  | C  | C  |    |  |
| Sundays   |  | C  | C | C | C | C | C | C                      | C | C | C | C  |    |    |    |    |    |           |    |    | C  | C  | C  | C  | C  |    |  |
| Legend:   |  |  |   |   |   |   |   |                        |   |   |   |    |    |    |    |    |    |           |    |    |    |    |    |    |    |    |  |
| C   |  | Connector may be closed completely.  |   |   |   |   |   |                        |   |   |   |    |    |    |    |    |    |           |    |    |    |    |    |    |    |    |  |
|   |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |   |   |   |                        |   |   |   |    |    |    |    |    |    |           |    |    |    |    |    |    |    |    |  |
| REMARKS: See Detour Plan #1   |  |  |   |   |   |   |   |                        |   |   |   |    |    |    |    |    |    |           |    |    |    |    |    |    |    |    |  |

| Chart No. 6<br>Complete Connector Closure Hours                          |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |           |    |    |    |    |    |    |    |    |    |    |    |  |
|--|--|--|---|---|------------------------|---|---|---|---|---|---|----|----|----|-----------|----|----|----|----|----|----|----|----|----|----|----|--|
| County: SM   |  |  |   |   | Route/Direction: 84/NB |   |   |   |   |   |   |    |    |    | PM: 24.83 |    |    |    |    |    |    |    |    |    |    |    |  |
| Closure Limits: On the Connector On-ramp from NB Route 82/El Camino Real |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |           |    |    |    |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR  |  | 24   | 1 | 2 | 3                      | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13        | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays  |  | C  | C | C | C                      | C | C | C |   |   |   |    |    |    |           |    |    |    |    |    |    | C  | C  | C  | C  |    |  |
| Fridays  |  | C  | C | C | C                      | C | C | C |   |   |   |    |    |    |           |    |    |    |    |    |    | C  | C  | C  | C  |    |  |
| Saturdays  |  | C  | C | C | C                      | C | C | C | C | C | C |    |    |    |           |    |    |    |    |    |    | C  | C  | C  | C  |    |  |
| Sundays  |  | C  | C | C | C                      | C | C | C | C | C | C | C  |    |    |           |    |    |    |    |    | C  | C  | C  | C  | C  |    |  |
| Legend:  |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |           |    |    |    |    |    |    |    |    |    |    |    |  |
| C  |  | Connector may be closed completely.  |   |   |                        |   |   |   |   |   |   |    |    |    |           |    |    |    |    |    |    |    |    |    |    |    |  |
|  |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |                        |   |   |   |   |   |   |    |    |    |           |    |    |    |    |    |    |    |    |    |    |    |  |
| REMARKS: See Detour Plan #2  |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |           |    |    |    |    |    |    |    |    |    |    |    |  |

| Chart No. 7<br>Complete Connector Closure Hours                          |  |  |   |   |   |   |   |                        |   |   |   |    |    |    |    |           |    |    |    |    |    |    |    |    |    |    |  |
|--|--|--|---|---|---|---|---|------------------------|---|---|---|----|----|----|----|-----------|----|----|----|----|----|----|----|----|----|----|--|
| County: SM   |  |  |   |   |   |   |   | Route/Direction: 84/SB |   |   |   |    |    |    |    | PM: 24.78 |    |    |    |    |    |    |    |    |    |    |  |
| Closure Limits: On the Connector On-ramp from NB Route 82/El Camino Real |  |  |   |   |   |   |   |                        |   |   |   |    |    |    |    |           |    |    |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR  |  | 24   | 1 | 2 | 3 | 4 | 5 | 6                      | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14        | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays  |  | C  | C | C | C | C | C | C                      |   |   |   |    |    |    |    |           |    |    |    |    |    | C  | C  | C  | C  |    |  |
| Fridays  |  | C  | C | C | C | C | C | C                      |   |   |   |    |    |    |    |           |    |    |    |    |    | C  | C  | C  | C  |    |  |
| Saturdays  |  | C  | C | C | C | C | C | C                      | C | C | C |    |    |    |    |           |    |    |    |    |    | C  | C  | C  | C  |    |  |
| Sundays  |  | C  | C | C | C | C | C | C                      | C | C | C | C  |    |    |    |           |    |    |    |    | C  | C  | C  | C  | C  |    |  |
| Legend:  |  |  |   |   |   |   |   |                        |   |   |   |    |    |    |    |           |    |    |    |    |    |    |    |    |    |    |  |
| C  |  | Connector may be closed completely.  |   |   |   |   |   |                        |   |   |   |    |    |    |    |           |    |    |    |    |    |    |    |    |    |    |  |
|  |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |   |   |   |                        |   |   |   |    |    |    |    |           |    |    |    |    |    |    |    |    |    |    |  |
| REMARKS: See Detour Plan #3  |  |  |   |   |   |   |   |                        |   |   |   |    |    |    |    |           |    |    |    |    |    |    |    |    |    |    |  |

| Chart No. 8<br>Complete Connector Closure Hours                   |  |  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
|---|--|--|---|---|-------------------------|---|---|---|---|---|---|----|----|----|----------|----|----|----|----|----|----|----|----|----|----|----|--|
| County: SM  |  |  |   |   | Route/Direction: 101/NB |   |   |   |   |   |   |    |    |    | PM: 1.78 |    |    |    |    |    |    |    |    |    |    |    |  |
| Closure Limits: On the Connector Off-ramp to NB Willow Rd/Rte 114 |  |  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR   |  | 24   | 1 | 2 | 3                       | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13       | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays   |  | C  | C | C | C                       | C | C |   |   |   |   |    |    |    |          |    |    |    |    |    |    | C  | C  | C  | C  |    |  |
| Fridays   |  | C  | C | C | C                       | C | C |   |   |   |   |    |    |    |          |    |    |    |    |    |    | C  | C  | C  | C  |    |  |
| Saturdays   |  | C  | C | C | C                       | C | C | C | C | C | C | C  | C  | C  | C        | C  |    |    |    | C  | C  | C  | C  | C  | C  |    |  |
| Sundays   |  | C  | C | C | C                       | C | C | C | C | C | C | C  | C  | C  | C        | C  | C  | C  | C  | C  | C  | C  | C  | C  | C  |    |  |
| Legend:   |  |  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
| C   |  | Connector may be closed completely.  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
|   |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
| REMARKS: See Detour Plan #6                                       |  |  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |

| Chart No. 9<br>Complete Connector Closure Hours                    |  |  |  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |
|--|--|--|--|---|---|-------------------------|---|---|---|---|---|---|----|----|----|----------|----|----|----|----|----|----|----|----|----|----|----|
| County: SM   |  |  |  |   |   | Route/Direction: 101/NB |   |   |   |   |   |   |    |    |    | PM: 1.85 |    |    |    |    |    |    |    |    |    |    |    |
| Closure Limits: On the Connector On-ramp from NB Willow Rd/Rte 114 |  |  |  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |
| FROM HOUR TO HOUR  |  |  | 24   | 1 | 2 | 3                       | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13       | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| Mondays through Thursdays  |  |  | C  | C | C | C                       | C | C |   |   |   |   |    |    |    |          |    |    |    |    | C  | C  | C  | C  | C  | C  |    |
| Fridays  |  |  | C  | C | C | C                       | C | C |   |   |   |   |    |    |    |          |    |    |    |    | C  | C  | C  | C  | C  | C  |    |
| Saturdays  |  |  | C  | C | C | C                       | C | C | C | C | C | C | C  | C  | C  | C        | C  | C  | C  | C  | C  | C  | C  | C  | C  | C  |    |
| Sundays  |  |  | C  | C | C | C                       | C | C | C | C | C | C | C  | C  | C  | C        | C  | C  | C  | C  | C  | C  | C  | C  | C  | C  |    |
| Legend:  |  |  |  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |
| <div>C</div>   |  |  | Connector may be closed completely.  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |
| <div></div>  |  |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |
| REMARKS: See Detour Plan # 7                                       |  |  |  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |

| Chart No. 10<br>Complete Connector Closure Hours   |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |  |
|--|----|---|---|---|-------------------------|---|---|---|---|---|----|----|----|----|----------|----|----|----|----|----|----|----|----|----|----|--|--|
| County: SM   |    |   |   |   | Route/Direction: 101/NB |   |   |   |   |   |    |    |    |    | PM: 5.24 |    |    |    |    |    |    |    |    |    |    |  |  |
| Closure Limits: On the Connector Segment Off-ramp to SB Woodside/Route 84                  |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |  |
| FROM HOUR TO HOUR  | 24 | 1 | 2 | 3 | 4                       | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14       | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |  |
| Mondays through Thursdays  | C  | C | C | C | C                       |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    | C  |  |  |
| Fridays  | C  | C | C | C | C                       |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |  |
| Saturdays  | C  | C | C | C | C                       | C | C |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |  |
| Sundays  | C  | C | C | C | C                       | C | C | C |   |   |    |    |    |    |          |    |    |    |    |    |    |    | C  | C  |    |  |  |
| Legend:  |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |  |
| C Connector may be closed completely.  |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |  |
| Work permitted within project right of way where shoulder or lane closure is not required. |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |  |
| REMARKS: See Detour Plan #10   |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |  |

| Chart No. 11<br>Complete Connector Closure Hours                          |  |  |   |   |   |                         |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |
|---|--|--|---|---|---|-------------------------|---|---|---|---|---|----|----|----|----|----------|----|----|----|----|----|----|----|----|----|----|--|
| County: SM  |  |  |   |   |   | Route/Direction: 101/SB |   |   |   |   |   |    |    |    |    | PM: 5.55 |    |    |    |    |    |    |    |    |    |    |  |
| Closure Limits: On the Connector Segment Off-ramp to SB Woodside/Route 84 |  |  |   |   |   |                         |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR   |  | 24   | 1 | 2 | 3 | 4                       | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14       | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays   |  | C  | C | C | C | C                       | C |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    | C  |  |
| Fridays   |  | C  | C | C | C | C                       | C |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |
| Saturdays   |  | C  | C | C | C | C                       | C | C |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |
| Sundays   |  | C  | C | C | C | C                       | C | C | C | C |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    | C  |  |
| Legend:   |  |  |   |   |   |                         |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |
| C   |  | Connector may be closed completely.  |   |   |   |                         |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |
|   |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |   |                         |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |
| REMARKS: See Detour Plan #11  |  |  |   |   |   |                         |   |   |   |   |   |    |    |    |    |          |    |    |    |    |    |    |    |    |    |    |  |

| Chart No. 12<br>Complete Connector Closure Hours                |  |  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
|---|--|--|---|---|-------------------------|---|---|---|---|---|---|----|----|----|----------|----|----|----|----|----|----|----|----|----|----|----|--|
| County: SM  |  |  |   |   | Route/Direction: 101/SB |   |   |   |   |   |   |    |    |    | PM: 5.17 |    |    |    |    |    |    |    |    |    |    |    |  |
| Closure Limits: On the Connector On-ramp from Woodside/Route 84 |  |  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR   |  | 24   | 1 | 2 | 3                       | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13       | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays                                       |  | C  | C | C | C                       | C | C |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    | C  | C  |    |  |
| Fridays   |  | C  | C | C | C                       | C | C |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    | C  |    |  |
| Saturdays   |  | C  | C | C | C                       | C | C | C | C |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    | C  |    |  |
| Sundays   |  | C  | C | C | C                       | C | C | C | C | C | C |    |    |    |          |    |    |    |    |    |    | C  | C  | C  | C  |    |  |
| Legend:   |  |  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
| C   |  | Connector may be closed completely.  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
|   |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
| REMARKS: See Detour Plan #12                                    |  |  |   |   |                         |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |

| Chart No. 13<br>Complete Connector Closure Hours   |  |  |  |  |  |  |  |                        |   |   |   |   |   |   |   |   |   |           |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|--|--|--|--|--|--|--|--|------------------------|---|---|---|---|---|---|---|---|---|-----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| County: SM   |  |  |  |  |  |  |  | Route/Direction: 84/SB |   |   |   |   |   |   |   |   |   | PM: 24.84 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Closure Limits: On the Connector Off-ramp to NB Route 82/El Camino Real                                |  |  |  |  |  |  |  |                        |   |   |   |   |   |   |   |   |   |           |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| FROM HOUR TO HOUR  |  |  |  |  |  |  |  | 24                     | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10        | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| Mondays through Thursdays  |  |  |  |  |  |  |  | C                      | C | C | C | C | C | C |   |   |   |           |    |    |    |    |    |    |    |    |    | C  | C  | C  | C  |    |
| Fridays  |  |  |  |  |  |  |  | C                      | C | C | C | C | C | C |   |   |   |           |    |    |    |    |    |    |    |    |    | C  | C  | C  | C  |    |
| Saturdays  |  |  |  |  |  |  |  | C                      | C | C | C | C | C | C | C | C | C |           |    |    |    |    |    |    |    |    | C  | C  | C  | C  | C  |    |
| Sundays  |  |  |  |  |  |  |  | C                      | C | C | C | C | C | C | C | C | C | C         |    |    |    |    |    |    |    | C  | C  | C  | C  | C  | C  |    |
| Legend:  |  |  |  |  |  |  |  |                        |   |   |   |   |   |   |   |   |   |           |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <div>C</div> Connector may be closed completely.   |  |  |  |  |  |  |  |                        |   |   |   |   |   |   |   |   |   |           |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <div></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |  |  |  |  |  |  |                        |   |   |   |   |   |   |   |   |   |           |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| REMARKS: See Detour Plan #13   |  |  |  |  |  |  |  |                        |   |   |   |   |   |   |   |   |   |           |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

| Chart No. 14<br>Complete Ramp Closure Hours        |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|--|--|--|--|--|--|--|--|--|---|---|---|---|---|---|---|---|---|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| County: SM   |  |  |  |  |  |  |  | Route/Direction: 101/NB  |   |   |   |   |   |   |   |   |   | PM: 0.77 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Closure Limits: On the Off-ramp to University Ave. |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| FROM HOUR TO HOUR                                  |  |  |  |  |  |  |  | 24   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10       | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| Mondays through Thursdays                          |  |  |  |  |  |  |  | C  | C | C | C | C | C | C |   |   |   |          |    |    |    |    |    |    |    |    |    | C  | C  | C  | C  |    |
| Fridays  |  |  |  |  |  |  |  | C  | C | C | C | C | C | C |   |   |   |          |    |    |    |    |    |    |    |    |    | C  | C  | C  | C  |    |
| Saturdays  |  |  |  |  |  |  |  | C  | C | C | C | C | C | C | C | C | C |          |    |    |    |    |    |    |    |    |    | C  | C  | C  | C  |    |
| Sundays  |  |  |  |  |  |  |  | C  | C | C | C | C | C | C | C | C | C | C        |    |    |    |    |    |    |    |    | C  | C  | C  | C  | C  |    |
| Legend:  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <div>C</div>                                       |  |  |  |  |  |  |  | Ramp may be closed completely.   |   |   |   |   |   |   |   |   |   |          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| <div></div>  |  |  |  |  |  |  |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |   |   |   |   |   |   |   |          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| REMARKS: Traffic detoured to the next off-ramp     |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

| Chart No. 15<br>Complete Ramp Closure Hours           |  |  |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
|---|--|--|---|---|---|---|---|-------------------------|---|---|---|----|----|----|----|----|----|----------|----|----|----|----|----|----|----|----|--|
| County: SM  |  |  |   |   |   |   |   | Route/Direction: 101/NB |   |   |   |    |    |    |    |    |    | PM: 0.88 |    |    |    |    |    |    |    |    |  |
| Closure Limits: On the Off-ramp to SB University Ave. |  |  |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR                                     |  | 24   | 1 | 2 | 3 | 4 | 5 | 6                       | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16       | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays                             |  | C  | C | C | C | C | C | C                       |   |   |   |    |    |    |    |    |    |          |    |    |    | C  | C  | C  | C  |    |  |
| Fridays   |  | C  | C | C | C | C | C | C                       |   |   |   |    |    |    |    |    |    |          |    |    |    | C  | C  | C  | C  |    |  |
| Saturdays   |  | C  | C | C | C | C | C | C                       | C | C | C | C  |    |    |    |    |    |          |    |    | C  | C  | C  | C  | C  |    |  |
| Sundays   |  | C  | C | C | C | C | C | C                       | C | C | C | C  | C  |    |    |    |    |          |    | C  | C  | C  | C  | C  | C  |    |  |
| Legend:   |  |  |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| <div>C</div>  |  | Ramp may be closed completely.   |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| <div></div>   |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| REMARKS: See Detour Plan #3A                          |  |  |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |

| Chart No. 16<br>Complete Ramp Closure Hours            |  |  |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
|--|--|--|---|---|---|---|---|-------------------------|---|---|---|----|----|----|----|----|----|----------|----|----|----|----|----|----|----|----|--|
| County: SM   |  |  |   |   |   |   |   | Route/Direction: 101/NB |   |   |   |    |    |    |    |    |    | PM: 1.09 |    |    |    |    |    |    |    |    |  |
| Closure Limits: On the On-ramp from SB University Ave. |  |  |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR                                      |  | 24   | 1 | 2 | 3 | 4 | 5 | 6                       | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16       | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays                              |  | C  | C | C | C | C | C | C                       |   |   |   |    |    |    |    |    |    |          |    |    |    |    | C  | C  | C  | C  |  |
| Fridays  |  | C  | C | C | C | C | C | C                       |   |   |   |    |    |    |    |    |    |          |    |    |    |    | C  | C  | C  | C  |  |
| Saturdays  |  | C  | C | C | C | C | C | C                       | C | C | C |    |    |    |    |    |    |          |    |    |    |    | C  | C  | C  | C  |  |
| Sundays  |  | C  | C | C | C | C | C | C                       | C | C | C | C  |    |    |    |    |    |          |    |    | C  | C  | C  | C  | C  |    |  |
| Legend:  |  |  |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| <div>C</div>   |  | Ramp may be closed completely.   |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| <div></div>  |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| REMARKS: See Detour Plan #4                            |  |  |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |



| <b>Chart No. 17</b>  |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |
|--|--|--|--|--|--|--|--|--|--|---|---|---|---|---|---|---|---|---|---|----------|--|--|--|--|--|--|--|--|--|---|---|---|---|---|---|
| <b>Complete Ramp Closure Hours</b>   |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |
| County: SM   |  |  |  |  |  |  |  |  |  | Route/Direction: 101/SB   |   |   |   |   |   |   |   |   |   | PM: 0.95 |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |
| Closure Limits: On the Off-ramp to University Ave.   |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |
| FROM HOUR TO HOUR  |  |  |  |  |  |  |  |  |  | 24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 |   |   |   |   |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |
| Mondays through Thursdays  |  |  |  |  |  |  |  |  |  | C   | C | C | C | C | C |   |   |   |   |          |  |  |  |  |  |  |  |  |  | C | C | C |   |   |   |
| Fridays  |  |  |  |  |  |  |  |  |  | C   | C | C | C | C | C |   |   |   |   |          |  |  |  |  |  |  |  |  |  | C | C |   |   |   |   |
| Saturdays  |  |  |  |  |  |  |  |  |  | C   | C | C | C | C | C | C | C | C |   |          |  |  |  |  |  |  |  |  |  |   | C | C | C | C |   |
| Sundays  |  |  |  |  |  |  |  |  |  | C   | C | C | C | C | C | C | C | C | C |          |  |  |  |  |  |  |  |  |  |   |   | C | C | C | C |
| <p>Legend:</p> <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px;"></div> Ramp may be closed completely <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px; margin-left: 20px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |
| REMARKS: Traffic detoured to the next off ramp   |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |

| <b>Chart No. 18</b>   |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |
|---|--|--|--|--|--|--|--|--|--|---|---|---|---|---|---|---|---|---|---|----------|--|--|--|--|--|--|--|--|--|---|---|---|---|---|---|
| <b>Complete Ramp Closure Hours</b>  |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |
| County: SM  |  |  |  |  |  |  |  |  |  | Route/Direction: 101/SB   |   |   |   |   |   |   |   |   |   | PM: 0.70 |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |
| Closure Limits: On the On-ramp from University Ave.   |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |
| FROM HOUR TO HOUR   |  |  |  |  |  |  |  |  |  | 24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 |   |   |   |   |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |
| Mondays through Thursdays   |  |  |  |  |  |  |  |  |  | C   | C | C | C | C |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  | C | C | C | C |   |   |
| Fridays   |  |  |  |  |  |  |  |  |  | C   | C | C | C | C |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  | C | C | C |   |   |   |
| Saturdays   |  |  |  |  |  |  |  |  |  | C   | C | C | C | C | C | C | C |   |   |          |  |  |  |  |  |  |  |  |  |   | C | C | C | C |   |
| Sundays   |  |  |  |  |  |  |  |  |  | C   | C | C | C | C | C | C | C | C | C |          |  |  |  |  |  |  |  |  |  |   |   | C | C | C | C |
| <p>Legend:</p> <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px;"></div> Ramp may be closed completely. <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px; margin-left: 20px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |
| REMARKS: See Detour Plan No. 5.   |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |   |   |   |   |          |  |  |  |  |  |  |  |  |  |   |   |   |   |   |   |

| <b>Chart No. 19</b>   |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
|---|--|----|---|---|---|---|---|-------------------------|---|---|---|----|----|----|----|----|----|----------|----|----|----|----|----|----|----|----|--|
| <b>Complete Ramp Closure Hours</b>  |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| County: SM  |  |    |   |   |   |   |   | Route/Direction: 101/NB |   |   |   |    |    |    |    |    |    | PM: 3.44 |    |    |    |    |    |    |    |    |  |
| Closure Limits: On the Off-ramp to Marsh Road   |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR   |  | 24 | 1 | 2 | 3 | 4 | 5 | 6                       | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16       | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays   |  | C  | C | C | C | C | C |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    | C  | C  | C  | C  |  |
| Fridays   |  | C  | C | C | C | C | C |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    | C  | C  | C  | C  |  |
| Saturdays   |  | C  | C | C | C | C | C | C                       | C | C |   |    |    |    |    |    |    |          |    |    |    |    | C  | C  | C  | C  |  |
| Sundays   |  | C  | C | C | C | C | C | C                       | C | C | C |    |    |    |    |    |    |          |    |    |    |    | C  | C  | C  | C  |  |
| <p>Legend:</p> <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px;"></div> Ramp may be closed completely. <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px; margin-top: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| REMARKS: Traffic detoured to the next off- ramp.  |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |

| <b>Chart No. 20</b>   |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
|---|--|----|---|---|---|---|---|-------------------------|---|---|---|----|----|----|----|----|----|----------|----|----|----|----|----|----|----|----|--|
| <b>Complete Ramp Closure Hours</b>  |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| County: SM  |  |    |   |   |   |   |   | Route/Direction: 101/SB |   |   |   |    |    |    |    |    |    | PM: 3.71 |    |    |    |    |    |    |    |    |  |
| Closure Limits: On the Off-ramp to Marsh Road   |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR   |  | 24 | 1 | 2 | 3 | 4 | 5 | 6                       | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16       | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays   |  | C  | C | C | C | C | C | C                       |   |   |   |    |    |    |    |    |    |          |    |    |    |    | C  | C  | C  | C  |  |
| Fridays   |  | C  | C | C | C | C | C | C                       |   |   |   |    |    |    |    |    |    |          |    |    |    |    | C  | C  | C  | C  |  |
| Saturdays   |  | C  | C | C | C | C | C | C                       | C | C | C |    |    |    |    |    |    |          |    |    |    | C  | C  | C  | C  | C  |  |
| Sundays   |  | C  | C | C | C | C | C | C                       | C | C | C | C  | C  |    |    |    |    |          |    | C  | C  | C  | C  | C  | C  | C  |  |
| <p>Legend:</p> <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px;"></div> Ramp may be closed completely. <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px; margin-top: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| REMARKS: Traffic detoured to the next off -ramp.  |  |    |   |   |   |   |   |                         |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |

| Chart No. 21<br>Complete Ramp Closure Hours       |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
|---|--|--|---|---|------------------------|---|---|---|---|---|---|----|----|----|----------|----|----|----|----|----|----|----|----|----|----|----|--|
| County: SM  |  |  |   |   | Route/Direction:101/SB |   |   |   |   |   |   |    |    |    | PM: 3.65 |    |    |    |    |    |    |    |    |    |    |    |  |
| Closure Limits: On the On-ramp from SB Marsh Road |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR                                 |  | 24   | 1 | 2 | 3                      | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13       | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays                         |  | C  | C | C | C                      | C | C | C | C | C | C | C  | C  | C  | C        | C  |    |    |    | C  | C  | C  | C  | C  | C  |    |  |
| Fridays   |  | C  | C | C | C                      | C | C | C | C | C | C | C  | C  | C  | C        | C  |    |    |    | C  | C  | C  | C  | C  | C  |    |  |
| Saturdays   |  | C  | C | C | C                      | C | C | C | C | C | C | C  | C  | C  | C        | C  | C  | C  | C  | C  | C  | C  | C  | C  | C  |    |  |
| Sundays   |  | C  | C | C | C                      | C | C | C | C | C | C | C  | C  | C  | C        | C  | C  | C  | C  | C  | C  | C  | C  | C  | C  |    |  |
| Legend:   |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
| <div>C</div>                                      |  | Ramp may be closed completely.   |   |   |                        |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
| <div></div>                                       |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |                        |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |
| REMARKS: See Detour Plan #8.                      |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |          |    |    |    |    |    |    |    |    |    |    |    |  |

| Chart No. 22<br>Complete Ramp Closure Hours       |  |  |   |   |   |   |   |                        |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
|---|--|--|---|---|---|---|---|------------------------|---|---|---|----|----|----|----|----|----|----------|----|----|----|----|----|----|----|----|--|
| County: SM  |  |  |   |   |   |   |   | Route/Direction:101/SB |   |   |   |    |    |    |    |    |    | PM: 3.48 |    |    |    |    |    |    |    |    |  |
| Closure Limits: On the On-ramp from NB Marsh Road |  |  |   |   |   |   |   |                        |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR                                 |  | 24   | 1 | 2 | 3 | 4 | 5 | 6                      | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16       | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays                         |  | C  | C | C | C | C | C | C                      |   |   |   |    |    |    |    |    |    |          |    |    | C  | C  | C  | C  | C  |    |  |
| Fridays   |  | C  | C | C | C | C | C | C                      |   |   |   |    |    |    |    |    |    |          |    |    | C  | C  | C  | C  | C  |    |  |
| Saturdays   |  | C  | C | C | C | C | C | C                      | C | C | C | C  | C  |    |    |    | C  | C        | C  | C  | C  | C  | C  | C  | C  |    |  |
| Sundays   |  | C  | C | C | C | C | C | C                      | C | C | C | C  | C  |    |    |    | C  | C        | C  | C  | C  | C  | C  | C  | C  |    |  |
| Legend:   |  |  |   |   |   |   |   |                        |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| <div>C</div>                                      |  | Ramp may be closed completely.   |   |   |   |   |   |                        |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| <div></div>                                       |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |   |   |   |                        |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |
| REMARKS: See Detour Plan #9.                      |  |  |   |   |   |   |   |                        |   |   |   |    |    |    |    |    |    |          |    |    |    |    |    |    |    |    |  |

| Chart No. 23<br>Conventional Highway Lane Requirements                     |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |
|--|--|--|---|---|------------------------|---|---|---|---|---|---|----|----|----|----------------|----|----|----|----|----|----|----|----|----|----|----|
| County: SCL  |  |  |   |   | Route/Direction: 82/NB |   |   |   |   |   |   |    |    |    | PM: 24.0/26.37 |    |    |    |    |    |    |    |    |    |    |    |
| Closure Limits: From Sand Hill Rd I/S to San Mateo/Santa Clara County Line |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |
| FROM HOUR TO HOUR  |  | 24   | 1 | 2 | 3                      | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13             | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| Mondays through Thursdays  |  | 1  | 1 | 1 | 1                      | 1 | 1 | 2 |   |   |   |    |    |    |                |    |    |    |    |    | S  | 2  | 2  | 2  | 1  |    |
| Fridays  |  | 1  | 1 | 1 | 1                      | 1 | 1 | 2 |   |   |   |    |    |    |                |    |    |    |    |    | S  | S  | 2  | 2  | 1  |    |
| Saturdays  |  | 1  | 1 | 1 | 1                      | 1 | 1 | 1 | 2 | 2 | S | S  |    |    |                |    |    |    |    |    | S  | S  | 2  | 2  | 1  |    |
| Sundays  |  | 1  | 1 | 1 | 1                      | 1 | 1 | 1 | 1 | 2 | 2 | S  | S  |    |                |    |    |    |    | S  | S  | 2  | 2  | 1  | 1  |    |
| Legend:  |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |
| 1  |  | Provide at least one through traffic lane open in direction of travel.                     |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |
| 2  |  | Provide at least two adjacent through traffic lanes open in direction of travel.           |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |
| S  |  | Shoulder closure permitted.  |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |
|  |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |
| REMARKS:   |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |

| Chart No. 24<br>Conventional Highway Lane Requirements                     |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |  |
|--|--|--|---|---|------------------------|---|---|---|---|---|---|----|----|----|----------------|----|----|----|----|----|----|----|----|----|----|----|--|
| County: SCL  |  |  |   |   | Route/Direction: 82/SB |   |   |   |   |   |   |    |    |    | PM: 24.0/26.37 |    |    |    |    |    |    |    |    |    |    |    |  |
| Closure Limits: From Sand Hill Rd I/S to San Mateo/Santa Clara County Line |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR  |  | 24   | 1 | 2 | 3                      | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13             | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays  |  | 1  | 1 | 1 | 1                      | 1 | 1 | 1 | 1 | S |   |    |    |    |                |    |    |    |    |    |    |    |    | S  | S  | 2  |  |
| Fridays  |  | 1  | 1 | 1 | 1                      | 1 | 1 | 1 | 1 | S |   |    |    |    |                |    |    |    |    |    |    |    |    | S  | S  | 2  |  |
| Saturdays  |  | 2  | 1 | 1 | 1                      | 1 | 1 | 1 | 1 | 2 | 2 | S  |    |    |                |    |    |    |    |    |    |    | S  | S  | S  | 2  |  |
| Sundays  |  | 2  | 1 | 1 | 1                      | 1 | 1 | 1 | 1 | 1 | 2 | 2  | S  |    |                |    |    |    |    |    |    |    | S  | 2  | 2  | 2  |  |
| Legend:  |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |  |
| 1  |  | Provide at least one through traffic lane open in direction of travel.                     |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |  |
| 2  |  | Provide at least two adjacent through traffic lanes open in direction of travel.           |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |  |
| S  |  | Shoulder closure permitted.  |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |  |
|  |  | Work permitted within project right of way where shoulder or lane closure is not required. |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |  |
| REMARKS:   |  |  |   |   |                        |   |   |   |   |   |   |    |    |    |                |    |    |    |    |    |    |    |    |    |    |    |  |

| <b>Chart No. 25</b>  |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |             |    |    |    |    |    |    |    |    |    |    |
|--|--|----|---|---|---|---|---|------------------------|---|---|---|----|----|----|----|-------------|----|----|----|----|----|----|----|----|----|----|
| <b>Conventional Highway Lane Requirements</b>  |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |             |    |    |    |    |    |    |    |    |    |    |
| County: SM   |  |    |   |   |   |   |   | Route/Direction: 82/NB |   |   |   |    |    |    |    | PM: 0.0/4.8 |    |    |    |    |    |    |    |    |    |    |
| Closure Limits: From San Mateo/Santa Clara County Line to Whipple Ave. I/S   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |             |    |    |    |    |    |    |    |    |    |    |
| FROM HOUR TO HOUR  |  | 24 | 1 | 2 | 3 | 4 | 5 | 6                      | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14          | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| Mondays through Thursdays  |  | 1  | 1 | 1 | 1 | 1 | 1 | 1                      | S | S | S | S  |    |    |    |             |    |    |    |    |    | S  | S  | 2  | 1  |    |
| Fridays  |  | 1  | 1 | 1 | 1 | 1 | 1 | 1                      | S | S | S | S  |    |    |    |             |    |    |    |    |    | S  | S  | 2  | 2  |    |
| Saturdays  |  | 1  | 1 | 1 | 1 | 1 | 1 | 1                      | 2 | 2 | S | S  |    |    |    |             |    |    |    |    | S  | S  | S  | 2  | 2  |    |
| Sundays  |  | 1  | 1 | 1 | 1 | 1 | 1 | 1                      | 1 | 2 | 2 | S  | S  |    |    |             |    |    |    | S  | S  | S  | 2  | 2  | 1  |    |
| <p>Legend:</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">1</div> Provide at least one through traffic lane open in direction of travel. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">2</div> Provide at least two adjacent through traffic lanes open in direction of travel. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">S</div> Shoulder closure permitted. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |             |    |    |    |    |    |    |    |    |    |    |
| REMARKS:   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |             |    |    |    |    |    |    |    |    |    |    |

| <b>Chart No. 26</b>   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |             |    |    |    |    |    |    |    |    |    |    |
|---|--|----|---|---|---|---|---|------------------------|---|---|---|----|----|----|----|-------------|----|----|----|----|----|----|----|----|----|----|
| <b>Conventional Highway Lane Requirements</b>   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |             |    |    |    |    |    |    |    |    |    |    |
| County: SM  |  |    |   |   |   |   |   | Route/Direction: 82/SB |   |   |   |    |    |    |    | PM: 0.0/4.8 |    |    |    |    |    |    |    |    |    |    |
| Closure Limits: From San Mateo/Santa Clara County Line to Whipple Ave. I/S  |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |             |    |    |    |    |    |    |    |    |    |    |
| FROM HOUR TO HOUR   |  | 24 | 1 | 2 | 3 | 4 | 5 | 6                      | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14          | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| Mondays through Thursdays   |  | 1  | 1 | 1 | 1 | 1 | 1 | 2                      |   |   |   |    |    |    |    |             |    |    |    |    |    | S  | 2  | 2  | 1  |    |
| Fridays   |  | 1  | 1 | 1 | 1 | 1 | 1 | 2                      |   |   |   |    |    |    |    |             |    |    |    |    |    |    | S  | 2  | 2  |    |
| Saturdays   |  | 1  | 1 | 1 | 1 | 1 | 1 | 1                      | 2 | S |   |    |    |    |    |             |    |    |    |    |    | S  | S  | 2  | 2  |    |
| Sundays   |  | 1  | 1 | 1 | 1 | 1 | 1 | 1                      | 2 | 2 | S |    |    |    |    |             |    |    |    |    | S  | S  | 2  | 2  | 1  |    |
| <p>Legend:</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">1</div> Provide at least one through traffic lane open in direction of travel. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">2</div> Provide at least two adjacent through traffic lanes open in direction of travel. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">S</div> Provide at least three adjacent through traffic lanes open in direction of travel. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |             |    |    |    |    |    |    |    |    |    |    |
| REMARKS:  |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |             |    |    |    |    |    |    |    |    |    |    |

| <b>Chart No. 27</b><br><b>Conventional Highway Lane Requirements</b>   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
|--|--|----|---|---|---|---|---|------------------------|---|---|---|----|----|----|----|----------------|----|----|----|----|----|----|----|----|----|----|--|
| County: SM   |  |    |   |   |   |   |   | Route/Direction: 84/NB |   |   |   |    |    |    |    | PM: 24.54/25.7 |    |    |    |    |    |    |    |    |    |    |  |
| Closure Limits: From Jct. Rte. 82 I/S to Jct. Rte 101 I/C  |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR  |  | 24 | 1 | 2 | 3 | 4 | 5 | 6                      | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14             | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays  |  | 1  | 1 | 1 | 1 | 1 | S |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    | S  | S  | 1  |  |
| Fridays  |  | 1  | 1 | 1 | 1 | 1 | S |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    | S  | S  | S  |  |
| Saturdays  |  | 1  | 1 | 1 | 1 | 1 | 1 | 1                      | S |   |   |    |    |    |    |                |    |    |    |    |    |    |    | S  | S  | S  |  |
| Sundays  |  | 1  | 1 | 1 | 1 | 1 | 1 | 1                      | S | S | S |    |    |    |    |                |    |    |    |    |    |    | S  | S  | S  | 1  |  |
| <p>Legend:</p> <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px;"></div> 1 Provide at least one through traffic lane open in direction of travel. <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px; margin-top: 5px;"></div> S Shoulder closure permitted. <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px; margin-top: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
| REMARKS:   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |

| <b>Chart No. 28</b><br><b>Conventional Highway Lane Requirements</b>   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
|--|--|----|---|---|---|---|---|------------------------|---|---|---|----|----|----|----|----------------|----|----|----|----|----|----|----|----|----|----|--|
| County: SM   |  |    |   |   |   |   |   | Route/Direction: 84/SB |   |   |   |    |    |    |    | PM: 24.54/25.7 |    |    |    |    |    |    |    |    |    |    |  |
| Closure Limits: From Jct. Rte. 82 I/S to Jct. Rte 101 I/C  |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
| FROM HOUR TO HOUR  |  | 24 | 1 | 2 | 3 | 4 | 5 | 6                      | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14             | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |  |
| Mondays through Thursdays  |  | 1  | 1 | 1 | 1 | 1 | 1 | S                      |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    | S  | S  | 1  |  |
| Fridays  |  | 1  | 1 | 1 | 1 | 1 | 1 | S                      |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    | S  | S  | S  |  |
| Saturdays  |  | 1  | 1 | 1 | 1 | 1 | 1 | 1                      | S |   |   |    |    |    |    |                |    |    |    |    |    |    |    | S  | S  | S  |  |
| Sundays  |  | 1  | 1 | 1 | 1 | 1 | 1 | 1                      | 1 | S | S |    |    |    |    |                |    |    |    |    |    |    | S  | S  | S  | 1  |  |
| <p>Legend:</p> <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px;"></div> 1 Provide at least one through traffic lane open in direction of travel. <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px; margin-top: 5px;"></div> S Shoulder closure permitted. <div style="border: 1px solid black; display: inline-block; width: 20px; height: 15px; margin-right: 5px; margin-top: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |
| REMARKS:   |  |    |   |   |   |   |   |                        |   |   |   |    |    |    |    |                |    |    |    |    |    |    |    |    |    |    |  |

| <b>Chart No. 29</b><br><b>Conventional Highway Lane Requirements</b>   |  |  |  |  |                         |   |   |   |   |   |   |   |   |   |              |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--|--|--|--|--|-------------------------|---|---|---|---|---|---|---|---|---|--------------|---|---|---|---|---|---|---|---|---|---|---|---|---|
| County: SM   |  |  |  |  | Route/Direction: 109/NB |   |   |   |   |   |   |   |   |   | PM: 1.1/1.87 |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Closure Limits: From north of Notre Dame Ave. to Jct. Route 84 I/S   |  |  |  |  |                         |   |   |   |   |   |   |   |   |   |              |   |   |   |   |   |   |   |   |   |   |   |   |   |
| FROM HOUR TO HOUR    24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24   |  |  |  |  |                         |   |   |   |   |   |   |   |   |   |              |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Mondays through Thursdays  |  |  |  |  | 1                       | 1 | 1 | 1 | 1 | 1 | 1 | S | S | 1 | 1            | 1 | S | S |   |   |   |   |   | S | S | 1 | 1 |   |
| Fridays  |  |  |  |  | 1                       | 1 | 1 | 1 | 1 | 1 | 1 | S | S | 1 | 1            | S | S | S |   |   |   |   |   | S | S | 1 | 1 |   |
| Saturdays  |  |  |  |  | 1                       | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1            | S | S | S | S | S | S | S | S | S | 1 | 1 | 1 | 1 |
| Sundays  |  |  |  |  | 1                       | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1            | 1 | S | S | S | S | S | S | S | S | 1 | 1 | 1 | 1 |
| <p>Legend:</p> <div style="display: flex; flex-direction: column; gap: 10px;"> <div> <div style="border: 1px solid black; width: 20px; height: 15px; display: inline-block; margin-right: 5px;"></div> 1 Provide at least one through traffic lane open in direction of travel. </div> <div> <div style="border: 1px solid black; width: 20px; height: 15px; display: inline-block; margin-right: 5px;"></div> S Shoulder closure permitted. </div> <div> <div style="border: 1px solid black; width: 20px; height: 15px; display: inline-block; margin-right: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. </div> </div> |  |  |  |  |                         |   |   |   |   |   |   |   |   |   |              |   |   |   |   |   |   |   |   |   |   |   |   |   |
| REMARKS:   |  |  |  |  |                         |   |   |   |   |   |   |   |   |   |              |   |   |   |   |   |   |   |   |   |   |   |   |   |

| <b>Chart No. 30</b><br><b>Conventional Highway Lane Requirements</b>   |  |  |  |  |                         |   |   |   |   |   |   |   |   |   |              |   |   |   |   |   |   |   |   |   |   |   |   |
|--|--|--|--|--|-------------------------|---|---|---|---|---|---|---|---|---|--------------|---|---|---|---|---|---|---|---|---|---|---|---|
| County: SM   |  |  |  |  | Route/Direction: 109/SB |   |   |   |   |   |   |   |   |   | PM: 1.1/1.87 |   |   |   |   |   |   |   |   |   |   |   |   |
| Closure Limits: From north of Notre Dame Ave. to Jct. Route 84 I/S   |  |  |  |  |                         |   |   |   |   |   |   |   |   |   |              |   |   |   |   |   |   |   |   |   |   |   |   |
| FROM HOUR TO HOUR    24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24   |  |  |  |  |                         |   |   |   |   |   |   |   |   |   |              |   |   |   |   |   |   |   |   |   |   |   |   |
| Mondays through Thursdays  |  |  |  |  | 1                       | 1 | 1 | 1 | 1 | 1 | S |   |   |   | S            | 1 | 1 | 1 | 1 | 1 | S | S | S | 1 | 1 | 1 | 1 |
| Fridays  |  |  |  |  | 1                       | 1 | 1 | 1 | 1 | 1 | S |   |   |   | S            | 1 | 1 | 1 | 1 | 1 | S | S | S | 1 | 1 | 1 | 1 |
| Saturdays  |  |  |  |  | 1                       | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | S            | S | S | S | S | S | S | S | S | 1 | 1 | 1 | 1 |
| Sundays  |  |  |  |  | 1                       | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1            | 1 | 1 | S | S | S | S | S | S | 1 | 1 | 1 | 1 |
| <p>Legend:</p> <div style="display: flex; flex-direction: column; gap: 10px;"> <div> <div style="border: 1px solid black; width: 20px; height: 15px; display: inline-block; margin-right: 5px;"></div> 1 Provide at least one through traffic lane open in direction of travel. </div> <div> <div style="border: 1px solid black; width: 20px; height: 15px; display: inline-block; margin-right: 5px;"></div> S Shoulder closure permitted. </div> <div> <div style="border: 1px solid black; width: 20px; height: 15px; display: inline-block; margin-right: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. </div> </div> |  |  |  |  |                         |   |   |   |   |   |   |   |   |   |              |   |   |   |   |   |   |   |   |   |   |   |   |
| REMARKS:   |  |  |  |  |                         |   |   |   |   |   |   |   |   |   |              |   |   |   |   |   |   |   |   |   |   |   |   |

| <b>Chart No. 31</b>  |  |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |
|--|--|----|---|---|---|-------------------------|---|---|---|---|---|----|----|----|----|--------------|----|----|----|----|----|----|----|----|----|----|
| <b>Conventional Highway Lane Requirements</b>  |  |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |
| County: SM   |  |    |   |   |   | Route/Direction: 114/NB |   |   |   |   |   |    |    |    |    | PM: 5.0/8.93 |    |    |    |    |    |    |    |    |    |    |
| Closure Limits: From Jct. Route 101 I/C to Jct. Route 84 I/S   |  |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |
| FROM HOUR TO HOUR  |  | 24 | 1 | 2 | 3 | 4                       | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14           | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| Mondays through Thursdays  |  | 1  | 1 | 1 | 1 | 1                       | 2 | S |   |   |   | S  | 2  | 2  | S  | S            | S  |    |    |    |    | S  | 2  | 2  | 2  | 1  |
| Fridays  |  | 1  | 1 | 1 | 1 | 1                       | 2 | S |   |   |   | S  | 2  | 2  | S  | S            | S  |    |    |    |    | S  | 2  | 2  | 2  | 1  |
| Saturdays  |  | 1  | 1 | 1 | 1 | 1                       | 1 | 1 | 1 | 2 | 2 | 2  | 2  | 2  | 2  | 2            | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 1  |
| Sundays  |  | 1  | 1 | 1 | 1 | 1                       | 1 | 1 | 1 | 1 | 2 | 2  | 2  | 2  | 2  | 2            | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 1  | 1  |    |
| <p>Legend:</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">1</div> Provide at least one through traffic lane open in direction of travel. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">2</div> Provide at least two adjacent through traffic lanes open in direction of travel. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">S</div> Shoulder closure permitted. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |
| REMARKS:   |  |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |

| <b>Chart No. 32</b>  |  |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |
|--|--|----|---|---|---|-------------------------|---|---|---|---|---|----|----|----|----|--------------|----|----|----|----|----|----|----|----|----|----|
| <b>Conventional Highway Lane Requirements</b>  |  |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |
| County: SM   |  |    |   |   |   | Route/Direction: 114/SB |   |   |   |   |   |    |    |    |    | PM: 5.0/8.93 |    |    |    |    |    |    |    |    |    |    |
| Closure Limits: From Jct. Route 101 I/C to Jct. Route 84 I/S   |  |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |
| FROM HOUR TO HOUR  |  | 24 | 1 | 2 | 3 | 4                       | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14           | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| Mondays through Thursdays  |  | 1  | 1 | 1 | 1 | 1                       | 2 | S |   |   |   | S  | S  | S  | S  | S            | S  |    |    |    |    | S  | 2  | 2  | 1  | 1  |
| Fridays  |  | 1  | 1 | 1 | 1 | 1                       | 2 | S |   |   |   | S  | S  | S  | S  | S            | S  |    |    |    |    | S  | 2  | 2  | 1  | 1  |
| Saturdays  |  | 1  | 1 | 1 | 1 | 1                       | 1 | 1 | 2 | 2 | 2 | 2  | 2  | 2  | 2  | 2            | 2  | 2  | 2  | 2  | 2  | 2  | 2  | 1  | 1  |    |
| Sundays  |  | 1  | 1 | 1 | 1 | 1                       | 1 | 1 | 1 | 1 | 2 | 2  | 2  | 2  | 2  | 2            | 2  | 2  | 2  | 2  | 2  | 2  | 1  | 1  | 1  |    |
| <p>Legend:</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">1</div> Provide at least one through traffic lane open in direction of travel. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">2</div> Provide at least two adjacent through traffic lanes open in direction of travel. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">S</div> Shoulder closure permitted. <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"></div> Work permitted within project right of way where shoulder or lane closure is not required. |  |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |
| REMARKS:   |  |    |   |   |   |                         |   |   |   |   |   |    |    |    |    |              |    |    |    |    |    |    |    |    |    |    |



### 10-1.13 CLOSURE REQUIREMENTS AND CONDITIONS

Closures shall conform to the provisions in "Maintaining Traffic" of these special provisions and these special provisions.

#### CLOSURE SCHEDULE

A written schedule of planned closures for the next week period, defined as Sunday noon through the following Sunday noon, shall be submitted by noon each Monday. A written schedule shall be submitted not less than 25 days and not more than 125 days before the anticipated start of any operation that will:

1. Reduce horizontal clearances, traveled way, including shoulders, to two lanes or less due to such operations as temporary barrier placement and paving
2. Reduce the vertical clearances available to the public due to such operations as pavement overlay, overhead sign installation, or falsework or girder erection

The Closure Schedule shall show the locations and times of the proposed closures. The Closure Schedule request forms furnished by the Engineer shall be used. Closure Schedules submitted to the Engineer with incomplete or inaccurate information will be rejected and returned for correction and resubmittal. The Contractor will be notified of disapproved closures or closures that require coordination with other parties as a condition of approval.

Closure Schedule amendments, including adding additional closures, shall be submitted by noon to the Engineer, in writing, at least 3 business days in advance of a planned closure. Approval of Closure Schedule amendments will be at the discretion of the Engineer.

The Engineer shall be notified of cancelled closures 2 business days before the date of closure.

Closures that are cancelled due to unsuitable weather may be rescheduled at the discretion of the Engineer.

#### CONTINGENCY PLAN

A detailed contingency plan shall be prepared for reopening closures to public traffic. If required by "Beginning of Work, Time of Completion and Liquidated Damages" of these special provisions, the contingency plan shall be submitted to the Engineer before work at the job site begins. Otherwise, the contingency plan shall be submitted to the Engineer within one business day of the Engineer's request.

#### LATE REOPENING OF CLOSURES

If a closure is not reopened to public traffic by the specified time, work shall be suspended in conformance with the provisions in Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications. No further closures are to be made until the Engineer has accepted a work plan, submitted by the Contractor, that will insure that future closures will be reopened to public traffic at the specified time. The Engineer will have 2 business days to accept or reject the Contractor's proposed work plan. The Contractor will not be entitled to compensation for the suspension of work resulting from the late reopening of closures.

For each 10-minute interval, or fraction thereof past the time specified to reopen the closure, the Department will deduct the amount per interval shown below from moneys due or that may become due the Contractor under the contract. Damages are limited to 5 percent of project cost per occurrence and will not be assessed when the Engineer requests that the closure remain in place beyond the scheduled pickup time.

| Type of Facility | Route or Segment         | Period              | Damages/interval (\$) |
|------------------|--------------------------|---------------------|-----------------------|
| Mainline         | SM 82, 84, 101, 109, 114 | 1st half hour       | \$1,000 / 10 minutes  |
|                  |                          | 2nd half hour       | \$1,000 / 10 minutes  |
|                  |                          | 2nd hour and beyond | \$1,000 / 10 minutes  |
| Connector        | 101/114                  | 1st half hour       | \$1,000 / 10 minutes  |
|                  |                          | 2nd half hour       | \$1,000 / 10 minutes  |
|                  |                          | 2nd hour and beyond | \$1,000 / 10 minutes  |
| Ramp             | 101                      | 1st half hour       | \$1,000 / 10 minutes  |
|                  |                          | 2nd half hour       | \$1,000 / 10 minutes  |
|                  |                          | 2nd hour and beyond | \$1,000 / 10 minutes  |

## **COMPENSATION**

The Engineer shall be notified of delays in the Contractor's operations due to the following conditions, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of those conditions, and the Contractor's loss due to that delay could not have been avoided by rescheduling the affected closure or by judicious handling of forces, equipment and plant, the delay will be considered a right of way delay and will be compensated in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications:

1. The Contractor's proposed Closure Schedule is denied and his planned closures are within the time frame allowed for closures in "Maintaining Traffic" of these special provisions, except that the Contractor will not be entitled to compensation for amendments to the Closure Schedule that are not approved.
2. The Contractor is denied a confirmed closure.

Should the Engineer direct the Contractor to remove a closure before the time designated in the approved Closure Schedule, delay to the Contractor's schedule due to removal of the closure will be considered a right of way delay and compensation for the delay will be determined in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

## **10-1.14 IMPACT ATTENUATOR VEHICLE**

### **GENERAL**

#### **Summary**

Work includes protecting traffic and workers by using impact attenuator vehicle as a shadow vehicle when placing and removing components of a traffic control system, and when performing a moving lane closure.

Comply with Section 12-3.03, "Flashing Arrow Signs," of the Standard Specifications.

Impact attenuator vehicle must comply with the following test levels under National Cooperative Highway Research Program 350:

1. Test level 3 for pre-construction posted speed limit of 50 mph or more
2. Test levels 2 or 3 for pre-construction posted speed limit of 45 mph or less

Comply with the attenuator manufacturer's recommendations for:

1. Support truck
2. Trailer-mounted operation
3. Truck-mounted operation

#### **Definitions**

**impact attenuator vehicle:** Support truck towing a deployed attenuator mounted to a trailer or support truck with a deployed attenuator mounted to the support truck.

#### **Submittals**

Upon request, submit a Certificate of Compliance for attenuator to the Engineer under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

#### **Quality Control and Assurance**

Attenuator must be a brand listed on the Department's pre-approved list under Highway Safety Features at:

[http://www.dot.ca.gov/hq/esc/approved\\_products\\_list/](http://www.dot.ca.gov/hq/esc/approved_products_list/)

## **MATERIALS**

The combined weight of the support truck and the attenuator must be at least 19,800 pounds, except the weight of the support truck must not be less than 16,100 pounds or greater than 26,400 pounds.

If using the Trinity MPS-350 truck-mounted attenuator, the support truck must not have any underneath fuel tank mounted within 10'-6" of the rear of the support truck.

Each impact attenuator vehicle must:

1. Have standard brake lights, taillights, sidelights, and turn signals

2. Have an inverted "V" chevron pattern placed across the entire rear of the attenuator composed of alternating 4 inch wide non-reflective black stripes and 4 inch wide yellow retroreflective stripes sloping at 45 degrees
3. Have a Type II flashing arrow sign
4. Have a flashing or rotating amber light
5. Have an operable 2-way communication system for maintaining contact with workers

## **CONSTRUCTION**

Use impact attenuator vehicle to follow behind equipment and workers who are placing and removing components of a traffic control system for a lane closure or a ramp closure. Flashing arrow sign must be operating in arrow mode during this activity. Follow at a distance to prevent intrusion into the workspace from passing traffic.

After placing components of a traffic control system for a lane closure or a ramp closure you may use impact attenuator vehicle in a closed lane and in advance of a work area to protect traffic and workers.

Use impact attenuator vehicle as a shadow vehicle under traffic control for a moving lane closure.

Secure objects including equipment, tools and ballast on impact attenuator vehicle to prevent loosening upon impact by an errant vehicle.

Do not use a damaged attenuator in the work. Replace, at your expense, an attenuator damaged from an impact during work.

## **MEASUREMENT AND PAYMENT**

Full compensation for furnishing and operating impact attenuator vehicle is included in the contract lump sum price paid for traffic control system, and no additional compensation will be allowed therefor.

### **10-1.15 TRAFFIC CONTROL SYSTEM FOR LANE CLOSURE**

A traffic control system shall consist of closing traffic lanes and ramps in conformance with the details shown on the plans, the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications, the provisions under "Maintaining Traffic" and "Construction Area Signs" of these special provisions, and these special provisions.

The provisions in this section will not relieve the Contractor of responsibility for providing additional devices or taking measures as may be necessary to comply with the provisions in Section 7-1.09, "Public Safety," of the Standard Specifications.

During traffic stripe operations and pavement marker placement operations using bituminous adhesive, traffic shall be controlled, at the option of the Contractor, with either stationary or moving lane closures. During other operations, traffic shall be controlled with stationary lane closures. Attention is directed to the provisions in Section 84-1.04, "Protection From Damage," and Section 85-1.06, "Placement," of the Standard Specifications.

If components in the traffic control system are displaced or cease to operate or function as specified, from any cause, during the progress of the work, the Contractor shall immediately repair the components to the original condition or replace the components and shall restore the components to the original location.

## **STATIONARY LANE CLOSURE**

When lane and ramp closures are made for work periods only, at the end of each work period, components of the traffic control system, except portable delineators placed along open trenches or excavation adjacent to the traveled way, shall be removed from the traveled way and shoulder. If the Contractor so elects, the components may be stored at selected central locations, designated by the Engineer within the limits of the highway right of way.

Each vehicle used to place, maintain and remove components of a traffic control system on multilane highways shall be equipped with a Type II flashing arrow sign which shall be in operation when the vehicle is being used for placing, maintaining or removing the components. Vehicles equipped with Type II flashing arrow sign not involved in placing, maintaining or removing the components when operated within a stationary type lane closure shall only display the caution display mode. The sign shall be controllable by the operator of the vehicle while the vehicle is in motion. The flashing arrow sign shown on the plans shall not be used on the vehicles which are doing the placing, maintaining and removing of components of a traffic control system and shall be in place before a lane closure requiring the sign's use is completed.

The 1,700-foot section of a lane closure, shown along lane lines between the 1,000-foot lane closure tapers on the plans entitled "Traffic Control System for Lane Closures on Freeways and Expressways" and "Traffic Control System for Lane and Complete Closures on Freeways and Expressways" shall not be used.

## **MOVING LANE CLOSURE**

Flashing arrow signs used in moving lane closures shall be truck-mounted. Changeable message signs used in moving lane closure operations shall conform to the provisions in Section 12-3.12, "Portable Changeable Message Signs," of the Standard Specifications, except the signs shall be truck-mounted and the full operation height of the bottom of the sign may be less than 7 feet above the ground, but should be as high as practicable.

Truck-mounted attenuators (TMA) for use in moving lane closures shall be any of the following approved models, or equal:

1. Hexfoam TMA Series 3000, Alpha 1000 TMA Series 1000, and Alpha 2001 TMA Series 2001, manufactured by Energy Absorption Systems, Inc., 35 East Wacker Drive, Suite 1100, Chicago, IL 60601:
  - 1.1. Northern California: Traffic Control Service, Inc., 8585 Thys Court, Sacramento, CA 95828, telephone (800) 884-8274, FAX (916) 387-9734
  - 1.2. Southern California: Traffic Control Service, Inc., 1818 E. Orangethorpe, Fullerton, CA 92831-5324, telephone (800) 222-8274, FAX (714) 526-9501
2. Cal T-001 Model 2 or Model 3, manufacturer and distributor: Hexcel Corporation, 11711 Dublin Boulevard, P.O. Box 2312, Dublin, CA 94568, telephone (925) 551-4900
3. Renco Rengard Model Nos. CAM 8-815 and RAM 8-815, manufacturer and distributor: Renco Inc., 1582 Pflugerville Loop Road, P.O. Box 730, Pflugerville, TX 78660-0730, telephone (800) 654-8182

Each TMA shall be individually identified with the manufacturer's name, address, TMA model number, and a specific serial number. The names and numbers shall each be a minimum 1/2 inch high and located on the left (street) side at the lower front corner. The TMA shall have a message next to the name and model number in 1/2 inch high letters which states, "The bottom of this TMA shall be \_\_\_\_\_ inches  $\pm$  \_\_\_\_\_ inch above the ground at all points for proper impact performance." Any TMA which is damaged or appears to be in poor condition shall not be used unless recertified by the manufacturer. The Engineer shall be the sole judge as to whether used TMAs supplied under this contract need recertification. Each unit shall be certified by the manufacturer to meet the requirements for TMA in conformance with the standards established by the Transportation Laboratory.

Approvals for new TMA designs proposed as equal to the above approved models shall be in conformance with the procedures (including crash testing) established by the Transportation Laboratory. For information regarding submittal of new designs for evaluation contact: Transportation Laboratory, 5900 Folsom Boulevard, Sacramento, California 95819.

New TMAs proposed as equal to approved TMAs or approved TMAs determined by the Engineer to need recertification shall not be used until approved or recertified by the Transportation Laboratory.

## **PAYMENT**

The contract lump sum price paid for traffic control system shall include full compensation for furnishing all labor, materials (including signs), tools, equipment, and incidentals, and for doing all the work involved in placing, removing, storing, maintaining, moving to new locations, replacing and disposing of the components of the traffic control system shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The adjustment provisions in Section 4-1.03, "Changes," of the Standard Specifications shall not apply to the item of traffic control system. Adjustments in compensation for traffic control system will be made only for increased or decreased traffic control system required by changes ordered by the Engineer and will be made on the basis of the cost of the increased or decreased traffic control necessary. The adjustment will be made on a force account basis as provided in Section 9-1.03, "Force Account Payment," of the Standard Specifications for increased work and estimated on the same basis in the case of decreased work.

Traffic control system required by work which is classed as extra work, as provided in Section 4-1.03D of the Standard Specifications, will be paid for as a part of the extra work.

## **10-1.16 PORTABLE CHANGEABLE MESSAGE SIGNS**

### **GENERAL**

#### **Summary**

Work includes furnishing, placing, operating, maintaining, and removing portable changeable message signs. Conform with Section 12-3.12, "Portable Changeable Message Signs," of the Standard Specifications.

## **Definitions**

**useable shoulder area:** Paved or unpaved contiguous surface adjacent to the traveled way with:

1. Sufficient weight bearing capacity to support portable changeable message sign
2. Slope not greater than 6:1 (horizontal:vertical)

## **Submittals**

Upon request, submit a Certificate of Compliance for each portable changeable message sign under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

## **Quality Control and Assurance**

Comply with the manufacturer's operating instructions for portable changeable message sign.

Approaching drivers must be able to read the entire message for all phases at least twice at the posted speed limit before passing portable changeable message sign. You may use more than 1 portable changeable message sign to meet this requirement.

Only display the message shown on the plans or ordered by the Engineer or specified in these special provisions.

## **MATERIALS**

The text of the message displayed on portable changeable message sign must not scroll, or travel horizontally or vertically across the face of the message panel.

## **CONSTRUCTION**

Continuously repeat the entire message in no more than 2 phases of at least 3 seconds per phase.

If useable shoulder area is at least 15 feet wide, the displayed message on portable changeable message sign must be minimum 18-inch character height. If useable shoulder area is less than 15 feet wide, you may use a smaller message panel with minimum 12-inch character height to prevent encroachment in the traveled way.

Start displaying the message on portable changeable message sign 5 minutes before closing the lane.

Place portable changeable message sign in advance of the first warning sign for:

1. Each stationary lane closure
2. Each off-ramp closure
3. Each connector closure
4. Each shoulder closure
5. Each speed reduction zone

Place portable changeable message sign as far from the traveled way as practicable where it is legible to traffic and does not encroach on the traveled way. Place portable changeable sign before or at the crest of vertical roadway curvature where it is visible to approaching traffic. Avoid placing portable changeable message sign within or immediately after horizontal roadway curvature. Where possible, place portable changeable message sign behind guardrail or temporary railing (Type K).

Except where placed behind guardrail or temporary railing (Type K) use traffic control for shoulder closure to delineate portable changeable message sign.

Remove portable changeable message sign when not in use.

## **MEASUREMENT AND PAYMENT**

The contract lump sum price paid for portable changeable message signs includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing, placing, operating, modifying messages, maintaining portable changeable message signs, complete in place, including transporting from location to location, removing, and repairing or replacing defective or damaged portable changeable message signs, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Portable changeable message signs ordered by the Engineer in excess of the number shown on the plans or specified in these special provisions will be paid for as extra work under Section 4-1.03D, "Extra Work," of the Standard Specifications.

### 10-1.17 TEMPORARY CRASH CUSHION MODULE

This work shall consist of furnishing, installing, and maintaining sand filled temporary crash cushion modules in groupings or arrays at each location shown on the plans, as specified in these special provisions or where designated by the Engineer. The grouping or array of sand filled modules shall form a complete sand filled temporary crash cushion in conformance with the details shown on the plans and these special provisions.

Temporary crash cushions shall be secured in place prior to commencing work for which the temporary crash cushions are required.

Whenever the work or the Contractor's operations establishes a fixed obstacle, the exposed fixed obstacle shall be protected with a sand filled temporary crash cushion. The sand filled temporary crash cushion shall be in place prior to opening the lanes adjacent to the fixed obstacle to public traffic.

Sand filled temporary crash cushions shall be maintained in place at each location, including times when work is not actively in progress. Sand filled temporary crash cushions may be removed during a work period for access to the work provided that the exposed fixed obstacle is 15 feet or more from a lane carrying public traffic and the temporary crash cushion is reset to protect the obstacle prior to the end of the work period in which the fixed obstacle was exposed. When no longer required, as determined by the Engineer, sand filled temporary crash cushions shall be removed from the site of the work.

Sand filled temporary crash cushion modules shall be one of the following, or equal, and be manufactured after March 31, 1997:

1. Energite III and Fitch Inertial Modules, manufactured by Energy Absorption Systems, Inc., 35 East Wacker Drive, Suite 1100, Chicago, IL 60601:
  - 1.1. Northern California: Traffic Control Service, Inc., 8585 Thys Court, Sacramento, CA 95828, telephone (800) 884-8274, FAX (916) 387-9734
  - 1.2. Southern California: Traffic Control Service, Inc., 1818 E. Orangethorpe, Fullerton, CA 92831-5324, telephone (800) 222-8274, FAX (714) 526-9501
2. Traffix Sand Barrels, manufactured by Traffix Devices, Inc., 220 Calle Pintoresco, San Clemente, CA 92672, telephone (949) 361-5663, FAX (949) 361-9205
  - 2.1. Northern California: United Rentals, Inc., 1533 Berger Drive, San Jose, CA 95112, telephone (408) 287-4303, FAX (408) 287-1929
  - 2.2. Southern California: Statewide Safety & Sign, Inc., P.O. Box 1440, Pismo Beach, CA 93448, telephone (800) 559-7080, FAX (805) 929-5786
3. CrashGard Model CC-48 Sand Barrels, manufactured by Plastic Safety Systems, Inc., 2444 Baldwin Road, Cleveland, OH 44104:
  - 3.1. Northern California:
    - 3.1.1. Capitol Barricade Safety & Sign, 6329 Elvas Ave, Sacramento, CA 95819, telephone (888) 868-5021, FAX (916) 451-5388
    - 3.1.2. Sierra Safety, Inc., 9093 Old State Highway, New Castle, CA 95658, telephone (916) 663-2026, FAX (916) 663-1858
  - 3.2. Southern California: Hi Way Safety Inc., 13310 5th Street, Chino, CA 91710, telephone (909) 591-1781, FAX (909) 627-0999

Modules contained in each temporary crash cushion shall be of the same type at each location. The color of the modules shall be the standard yellow color, as furnished by the vendor, with black lids. The modules shall exhibit good workmanship free from structural flaws and objectionable surface defects. The modules need not be new. Good used undamaged modules conforming to color and quality of the types specified herein may be utilized. If used Fitch modules requiring a seal are furnished, the top edge of the seal shall be securely fastened to the wall of the module by a continuous strip of heavy duty tape.

Modules shall be filled with sand in conformance with the manufacturer's directions, and to the sand capacity in pounds for each module shown on the plans. Sand for filling the modules shall be clean washed concrete sand of commercial quality. At the time of placing in the modules, the sand shall contain not more than 7 percent water as determined by California Test 226.

Modules damaged due to the Contractor's operations shall be repaired immediately by the Contractor at the Contractor's expense. Modules damaged beyond repair, as determined by the Engineer, due to the Contractor's operations shall be removed and replaced by the Contractor at the Contractor's expense.

Temporary crash cushion modules may be placed on movable pallets or frames. Comply with dimensions shown on the plans. The pallets or frames shall provide a full bearing base beneath the modules. The modules and supporting pallets or frames shall not be moved by sliding or skidding along the pavement or bridge deck.

A Type R or P marker panel shall be attached to the front of the crash cushion as shown on the plans, when the closest point of the crash cushion array is within 12 feet of the traveled way. The marker panel, when required, shall be firmly fastened to the crash cushion with commercial quality hardware or by other methods determined by the Engineer.

At the completion of the project, temporary crash cushion modules, sand filling, pallets or frames, and marker panels shall become the property of the Contractor and shall be removed from the site of the work. Temporary crash cushion modules shall not be installed in the permanent work.

Temporary crash cushion modules placed in conformance with Section 7-1.09, "Public Safety," of the Standard Specifications will not be measured nor paid for.

### **10-1.18 EXISTING HIGHWAY FACILITIES**

The work performed in connection with various existing highway facilities shall conform to the provisions in Section 15, "Existing Highway Facilities," of the Standard Specifications and these special provisions.

#### **COLD PLANE ASPHALT CONCRETE PAVEMENT**

##### **GENERAL**

###### **Summary**

This work includes cold planing existing asphalt concrete pavement.

###### **Sequencing and Scheduling**

Schedule cold planing activities to ensure hot mix asphalt (HMA) is placed over cold planed area during the same work shift before opening to traffic. If you cannot place HMA over the entire cold planed area before opening it to traffic:

1. Construct a temporary HMA taper to the level of the existing pavement.
2. Place HMA during the next lane or shoulder closure for that area.
3. Submit a corrective action plan that shows that you are able to cold plane and place HMA in the same work shift. Do not perform cold planing work until the Engineer approves the corrective action plan.

##### **MATERIALS**

HMA for temporary tapers must be of the same quality as the HMA used elsewhere on the project or comply with "Minor Hot Mix Asphalt" of these special provisions.

##### **CONSTRUCTION**

###### **General**

Perform planing of asphalt concrete pavement without the use of a heating device to soften the pavement.

###### **Cold Planing Equipment**

Cold planing machine must be:

1. Equipped with a cutter head width that matches the planing width. If the only available cutter head width is wider than the cold plane area shown, submit to the Engineer a request for using a wider cutter head. Do not cold plane until the Engineer approves your request.
2. Equipped with automatic controls to control the longitudinal grade and transverse slope of the cutter head and:
  - 2.1. If a ski device is used, it must be at least 30 feet long, rigid, and 1 piece unit. The entire length must be used in activating the sensor.
  - 2.2. If referencing from existing pavement, the cold planing machine must be controlled by a self-contained grade reference system. The system must be used at or near the centerline of the roadway. On the adjacent pass with the cold planing machine, a joint matching shoe may be used.

3. Equipped to effectively control dust generated by the planing operation.
4. Operated so that no fumes or smoke is produced.

Replace broken, missing, or worn machine teeth.

#### **Grade Control and Surface Smoothness**

Furnish, install, and maintain grade and transverse slope references.

The depth, length, width, and shape of the cut must be as shown or as ordered. The final cut must result in a neat and uniform surface. Do not damage remaining surface.

The completed surface of the planed asphalt concrete pavement must not vary more than 0.02 foot when measured with a 12-foot straightedge parallel with the centerline. The transverse slope of the planed surface must not vary more than 0.03 foot from the straightedge when placed at right angles to the centerline.

A drop-off of more than 0.15 foot is not allowed between adjacent lanes open to public traffic.

#### **Temporary HMA Tapers**

If a drop-off between the existing pavement and the planed area at transverse joints cannot be avoided before opening to traffic, construct a temporary HMA taper. HMA for temporary taper must be:

1. Placed to the level of the existing pavement and tapered on a slope of 30:1 (Horizontal: Vertical) or flatter to the level of the planed area
2. Compacted by any method that will produce a smooth riding surface
3. Completely removed before placing the permanent surfacing. The removed material must be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

#### **Disposal of Planed Material**

Remove cold planed material concurrent with planing activities, within 50 feet of the planer or as ordered.

Dispose of planed material under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

#### **MEASUREMENT AND PAYMENT**

Cold plane asphalt concrete pavement is measured by the square yard.

The contract price paid per square yard for cold plane asphalt concrete pavement includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in cold planing asphalt concrete surfacing and disposing of planed material, including constructing, maintaining, removing temporary HMA tapers if applicable, as specified in the Standard Specifications and these special provisions and as directed by the Engineer.

Full compensation for removal of thermoplastic traffic stripe, painted traffic stripe, and pavement marking in areas of cold plane asphalt concrete is included in the contract price paid for cold plane asphalt concrete and no separate payment will be made therefor.

#### **10-1.19 CLEARING AND GRUBBING**

Clearing and grubbing shall conform to the provisions in Section 16, "Clearing and Grubbing," of the Standard Specifications and these special provisions.

Vegetation shall be cleared and grubbed only within the excavation and embankment slope lines.

#### **10-1.20 WATERING**

Developing a water supply and applying watering shall conform to the provisions in Section 17, "Watering," of the Standard Specifications and these special provisions.

Attention is directed to "Beginning of Work, Time of Completion and Liquidated Damages" of these special provisions regarding availability of water.

#### **10-1.21 EARTHWORK**

Earthwork shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications and these special provisions.



Where a portion of the existing surfacing is to be removed, the outline of the area to be removed shall be cut on a neat line with a power-driven saw to a minimum depth of 0.17-foot before removing the surfacing. Full compensation for cutting the existing surfacing shall be considered as included in the prices paid per the various contract items of work and no additional compensation will be allowed therefor.

Reinforcement or metal attached to reinforced concrete rubble placed in embankments shall not protrude above the grading plane. Prior to placement within 2 feet below the grading plane of embankments, reinforcement or metal shall be trimmed to no greater than 3/4 inch from the face of reinforced concrete rubble. Full compensation for trimming reinforcement or metal shall be considered as included in the prices paid per the various contract items of work, and no additional compensation will be allowed therefor.

#### **10-1.22 MULCH**

This work includes spreading mulch on embankment slopes, excavation slopes, and areas shown on the plans. Mulch must comply with Section 20-3, "Erosion Control," of the Standard Specifications.

If the slope on which the mulch is to be placed is finished during the rainy season as specified in "Water Pollution Control" of these special provisions, apply mulch immediately to the slope.

#### **MATERIALS**

##### **Mulch**

Mulch must be wood chips. Wood chips produced from tree trimmings may contain leaves and small twigs.

#### **CONSTRUCTION**

##### **Application**

Spread mulch to a uniform thickness. Extend mulch to the edge of retaining walls, dikes, paving and to within 4 feet from the flow line of paved and unpaved drainage ditches.

#### **MEASUREMENT AND PAYMENT**

Quantities of mulch will be measured by the cubic yard in the vehicle at the point of delivery.

The contract price paid per cubic yard for mulch includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in providing mulch complete in place, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

#### **10-1.23 HOT MIX ASPHALT**

##### **GENERAL**

##### **Summary**

This work includes producing and placing hot mix asphalt (HMA) Type A using the Standard process. Comply with Section 39, "Hot Mix Asphalt," of the Standard Specifications.

#### **MATERIALS**

##### **Asphalt Binder**

The grade of asphalt binder mixed with aggregate for HMA Type A must be PG 64-10.

##### **Aggregate**

The aggregate for HMA Type A must comply with the 3/4-inch grading.

#### **10-1.24 MINOR HOT MIX ASPHALT**

##### **GENERAL**

##### **Summary**

This work includes producing hot mix asphalt (HMA) at a central mixing plant and placing it as specified.

#### **MATERIALS**

For minor HMA:

1. Do not submit a job mix formula.
2. Choose the 3/8-inch or 1/2-inch HMA Type A or Type B aggregate gradation under Section 39-1.02E, "Aggregate," of the Standard Specifications.

3. Minimum asphalt binder content must be 6.8 percent for 3/8-inch aggregate gradation and 6.0 percent for 1/2-inch aggregate gradation.
4. Choose asphalt binder Grade PG 64-10, PG 64-16, or PG 70-10 under Section 92, "Asphalts," of the Standard Specifications.

If you request and the Engineer authorizes, you may reduce the minimum asphalt binder content.  
Tack coat must comply with Section 39, "Hot Mix Asphalt," of the Standard Specifications.

## **CONSTRUCTION**

Spread and compact minor HMA by methods that produce an HMA surfacing:

1. Textured uniformly
2. Compacted firmly
3. Without depressions, humps, and irregularities

### **10-1.25 PILING**

#### **GENERAL**

Piling shall conform to the provisions in Section 49, "Piling," of the Standard Specifications, and these special provisions.

Unless otherwise specified, welding of any work performed in conformance with the provisions in Section 49, "Piling," of the Standard Specifications, shall be in conformance with the requirements in AWS D1.1.

Attention is directed to "Welding" of these special provisions.

Difficult pile installation is anticipated due to the presence of contaminated materials, high ground water, underground utilities, overhead utilities and traffic control.

#### **CAST-IN-DRILLED-HOLE CONCRETE PILES**

##### **GENERAL**

##### **Summary**

Cast-in-drilled-hole (CIDH) concrete piling shall conform to the provisions in Section 49-4, "Cast-In-Place Concrete Piles," of the Standard Specifications and these special provisions.

The provisions of "Welding" of these special provisions shall not apply to temporary steel casings.

##### **Definitions**

##### **dry hole:**

1. Except for CIDH concrete piles specified as end bearing, a drilled hole that:
  - 1.1. Accumulates no more than 12 inches of water in the bottom of the drilled hole during a period of 1 hour without any pumping from the hole during the hour.
  - 1.2. Has no more than 3 inches of water in the bottom of the drilled hole immediately before placing concrete.
2. For CIDH concrete piles specified as end bearing, a drilled hole free of water without the use of pumps.

##### **Submittals**

##### **Pile Installation Plan**

The Contractor shall submit a pile installation plan to the Engineer for approval for all CIDH concrete piling. The pile installation plan shall be submitted at least 15 days before constructing CIDH concrete piling and shall include complete descriptions, details, and supporting calculations for the following:

- A. Concrete mix design, certified test data, and trial batch reports.
- B. Drilling or coring methods and equipment.
- C. Proposed method for casing installation and removal when necessary.
- D. Methods for placing, positioning, and supporting bar reinforcement. If plastic spacers are proposed for use, include the manufacturer's data and a sample of the plastic spacer.
- E. Methods and equipment for determining the depth of concrete and actual and theoretical volume placed, including effects on volume of concrete when any casings are withdrawn.
- F. Methods and equipment for verifying that the bottom of the drilled hole is clean before placing concrete.

- G. Methods and equipment for preventing upward movement of reinforcement, including the Contractor's means of detecting and measuring upward movement during concrete placement operations.

For concrete placed under slurry, the pile installation plan shall also include complete descriptions, details, and supporting calculations for the following:

- A. Concrete batching, delivery, and placing systems, including time schedules and capacities. Time schedules shall include the time required for each concrete placing operation at each pile.
- B. Concrete placing rate calculations. When requested by the Engineer, calculations shall be based on the initial pump pressures or static head on the concrete and losses throughout the placing system, including anticipated head of slurry and concrete to be displaced.
- C. Suppliers' test reports on the physical and chemical properties of the slurry and any proposed slurry chemical additives, including Material Safety Data Sheet.
- D. Slurry testing equipment and procedures.
- E. Methods of removal and disposal of excavation, slurry, and contaminated concrete, including removal rates.
- F. Methods and equipment for slurry agitating, recirculating, and cleaning.

## **QUALITY ASSURANCE**

### **Concrete Test Batch**

Before concrete is deposited under slurry, a concrete test batch shall be produced and delivered to the project under conditions and in time periods similar to those expected during placement of concrete in the piles. Concrete shall be placed in an excavated hole or suitable container of adequate size to allow for testing as specified herein. Depositing of concrete under slurry will not be required. In addition to meeting the specified nominal slump, the concrete test batch shall meet the following requirements:

- A. For piles where the time required for each concrete placing operation, as submitted in the placing plan, will be 2 hours or less, the concrete test batch shall demonstrate that the proposed concrete mix design achieves a slump of at least 7 inches after twice that time has elapsed.
- B. For piles where the time required for each concrete placing operation, as submitted in the placing plan, will be more than 2 hours, the concrete test batch shall demonstrate that the proposed concrete mix design achieves a slump of at least 7 inches after that time plus 2 hours has elapsed.

The time period shall begin at the start of placement. Concrete shall not be vibrated or agitated during the test period. Slump tests will be performed in conformance with the requirements in California Test 556.

Upon completion of testing, concrete shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

### **Preconstruction Meeting**

A preconstruction meeting for CIDH concrete pile construction shall be held (1) at least 5 business days after submitting the pile installation plan and (2) at least 10 days before the start of CIDH concrete pile construction.

The meeting shall include the Engineer, the Contractor, and any subcontractors involved in the CIDH concrete pile construction.

The purpose of this meeting is to:

- A. Establish contacts and communication protocol between the Contractor, any subcontractors involved in CIDH concrete pile construction, and the Engineer
- B. Review the construction process, acceptance testing, and anomaly mitigation of CIDH concrete piles

The Contractor shall schedule the meeting and provide a facility for the meeting. The Engineer will conduct the meeting. The following will be discussed:

- A. Pile placement plan, dry and wet
- B. Acceptance testing, including gamma-gamma logging, cross-hole sonic logging, and coring
- C. Pile Design Data Form
- D. Mitigation process
- E. Timeline and critical path activities
- F. Structural, geotechnical, and corrosion design requirements
- G. Future meetings, if necessary, for pile mitigation and pile mitigation plan review

H. Safety requirements, including Cal/OSHA and Tunnel Safety Orders

**MATERIALS**

**Concrete**

Concrete deposited under slurry shall have a nominal slump equal to or greater than 7 inches, contain not less than 675 pounds of cementitious material per cubic yard, and be proportioned to prevent excessive bleed water and segregation. The nominal and maximum slump and penetration requirements in Section 90-6.06, "Amount of Water and Penetration," of the Standard Specifications shall not apply.

Concrete shall conform to the requirements in "Corrosion Control for Portland Cement Concrete" of these special provisions.

**Aggregate Grading**

The combined aggregate grading shall be either the 1-inch maximum grading, the 1/2-inch maximum grading, or the 3/8-inch maximum grading and shall conform to the requirements in Section 90-3, "Aggregate Gradings," of the Standard Specifications.

When concrete is placed under slurry, the combined aggregate grading shall be either the 1/2-inch maximum grading or the 3/8-inch maximum grading and shall conform to the requirements in Section 90-3, "Aggregate Gradings," of the Standard Specifications.

**Spacers**

Spacers shall conform to Section 52-1.07, "Placing," of the Standard Specifications, except plastic spacers may be used.

Plastic spacers shall conform to Sections 3.4 and 3.5 of the Concrete Reinforcing Steel Institute's "Manual of Standard Practice" and shall have at least 25 percent of their gross plane area perforated to compensate for the difference in the coefficient of thermal expansion between the plastic and concrete. Plastic spacers shall be commercial quality.

**Slurry**

**Mineral Slurry**

Mineral slurry shall be mixed and thoroughly hydrated in slurry tanks, and slurry shall be sampled from the slurry tanks and tested before placement in the drilled hole.

Slurry shall be recirculated or continuously agitated in the drilled hole to maintain the specified properties.

Recirculation shall include removal of drill cuttings from the slurry before discharging the slurry back into the drilled hole. When recirculation is used, the slurry shall be sampled and tested at least every 2 hours after beginning its use until tests show that the samples taken from the slurry tank and from near the bottom of the hole have consistent specified properties. Subsequently, slurry shall be sampled at least twice per shift as long as the specified properties remain consistent.

Slurry that is not recirculated in the drilled hole shall be sampled and tested at least every 2 hours after beginning its use. The slurry shall be sampled mid-height and near the bottom of the hole. Slurry shall be recirculated when tests show that the samples taken from mid-height and near the bottom of the hole do not have consistent specified properties.

Slurry shall also be sampled and tested before final cleaning of the bottom of the hole and again just before placing concrete. Samples shall be taken from mid-height and near the bottom of the hole. Cleaning of the bottom of the hole and placement of the concrete shall not start until tests show that the samples taken from mid-height and near the bottom of the hole have consistent specified properties.

Mineral slurry shall be tested for conformance to the requirements shown in the following table:

| MINERAL SLURRY  |                                      |  |
|---|--------------------------------------|--|
| PROPERTY  | REQUIREMENT                          | TEST   |
| Density (pcf )<br><br>- before placement in the drilled hole<br>- during drilling<br><br>- before final cleaning<br>- immediately before placing concrete                           | 64.3* to 69.1*<br><br>64.3* to 75.0* | Mud Weight (Density)<br>API 13B-1<br>Section 1   |
| Viscosity (seconds/quart)<br><br>bentonite<br><br>attapulgate   | 28 to 50<br><br>28 to 40             | Marsh Funnel and Cup<br>API 13B-1<br>Section 2.2 |
| pH  | 8 to 10.5                            | Glass Electrode pH Meter or pH Paper             |
| Sand Content (percent)<br><br>- before final cleaning<br>- immediately before placing concrete  | less than or equal to 4.0            | Sand<br>API 13B-1<br>Section 5                   |
| *When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40 °F when tested. |                                      |  |

Any caked slurry on the sides or bottom of hole shall be removed before placing reinforcement. If concrete is not placed immediately after placing reinforcement, the reinforcement shall be removed and cleaned of slurry, the sides of the drilled hole cleaned of caked slurry, and the reinforcement again placed in the hole for concrete placement.

### **Synthetic Slurry**

Synthetic slurries shall be used in conformance with the manufacturer's recommendations and these special provisions. The following synthetic slurries may be used:

| PRODUCT                     | MANUFACTURER   |
|-----------------------------|--|
| SlurryPro CDP               | KB International LLC<br>735 Board Street, Suite 209<br>Chattanooga, TN 37402<br>(423) 266-6964           |
| Super Mud                   | PDS Co., Inc.<br>105 West Sharp Street<br>El Dorado, AR 71731<br>(870) 863-5707                          |
| Shore Pac GCV               | CETCO Construction Drilling Products<br>2870 Forbs Avenue<br>Hoffman Estates, IL 60192<br>(800) 527-9948 |
| Terragel or Novagel Polymer | Geo-Tech Services, LLC<br>220 N. Zapata Hwy, Suite 11A-449A<br>Laredo, TX 78043<br>(210) 259-6386        |

Inclusion of a synthetic slurry on the above list may be obtained by meeting the Department's requirements for synthetic slurries. The requirements can be obtained from the Offices of Structures Design, P.O. Box 168041, MS# 9-4/11G, Sacramento, CA 95816-8041.

Synthetic slurries listed may not be appropriate for a given site.

Synthetic slurries shall not be used in holes drilled in primarily soft or very soft cohesive soils as determined by the Engineer.

A manufacturer's representative, as approved by the Engineer, shall provide technical assistance for the use of their product, shall be at the site before introduction of the synthetic slurry into a drilled hole, and shall remain at the site until released by the Engineer.

Synthetic slurries shall be sampled and tested at both mid-height and near the bottom of the drilled hole. Samples shall be taken and tested during drilling as necessary to verify the control of the properties of the slurry. Samples shall be taken and tested when drilling is complete, but before final cleaning of the bottom of the hole. When samples are in conformance with the requirements shown in the following tables for each slurry product, the bottom of the hole shall be cleaned and any loose or settled material removed. Samples shall be obtained and tested after final cleaning and immediately before placing concrete.

SlurryPro CDP synthetic slurries shall be tested for conformance to the requirements shown in the following table:

| SLURRYPRO CDP<br>KB International LLC   |  |  |
|---|--|--|
| PROPERTY  | REQUIREMENT  | TEST   |
| Density (pcf )<br><br>- during drilling<br><br>- before final cleaning<br>- just before placing concrete  | less than or equal to 67.0*<br><br>less than or equal to 64.0* | Mud Weight (Density)<br>API 13B-1<br>Section 1   |
| Viscosity (seconds/quart)<br><br>- during drilling<br><br>-before final cleaning<br>- just before placing concrete  | 50 to 120<br><br>less than or equal to 70                      | Marsh Funnel and Cup<br>API 13B-1<br>Section 2.2 |
| pH  | 6 to 11.5  | Glass Electrode pH Meter or pH Paper             |
| Sand Content (percent)<br><br>- before final cleaning<br>- just before placing concrete   | less than or equal to 0.5                                      | Sand<br>API 13B-1<br>Section 5                   |
| *When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40 °F when tested. |  |  |

Super Mud synthetic slurries shall be tested for conformance to the requirements shown in the following table:

| SUPER MUD<br>PDS Co., Inc.  |  |  |
|---|--|--|
| PROPERTY  | REQUIREMENT                                  | TEST   |
| Density (pcf)<br><br>- before final cleaning<br>- just before placing concrete  | less than or equal to 64.0*                  | Mud Weight (Density)<br>API 13B-1<br>Section 1   |
| Viscosity (seconds/quart)<br><br>- during drilling<br><br>- before final cleaning<br>- just before placing concrete   | 32 to 60<br><br><br>less than or equal to 60 | Marsh Funnel and Cup<br>API 13B-1<br>Section 2.2 |
| pH  | 8 to 10.0                                    | Glass Electrode pH Meter or pH Paper             |
| Sand Content (percent)<br><br>- before final cleaning<br>- just before placing concrete   | less than or equal to 0.5                    | Sand<br>API 13B-1<br>Section 5                   |
| *When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40 °F when tested. |  |  |



Shore Pac GCV synthetic slurries shall be tested for conformance to the requirements shown in the following table:

| Shore Pac GCV<br>CETCO Construction Drilling Products   |  |  |
|---|--|--|
| PROPERTY  | REQUIREMENT                                  | TEST   |
| Density (pcf)<br><br>- before final cleaning<br>- just before placing concrete  | less than or equal to 64.0*                  | Mud Weight (Density)<br>API 13B-1<br>Section 1   |
| Viscosity (seconds/quart)<br><br>- during drilling<br><br>- before final cleaning<br>- just before placing concrete   | 33 to 74<br><br><br>less than or equal to 57 | Marsh Funnel and Cup<br>API 13B-1<br>Section 2.2 |
| pH  | 8.0 to 11.0                                  | Glass Electrode pH Meter or pH Paper             |
| Sand Content (percent)<br><br>- before final cleaning<br>- just before placing concrete   | less than or equal to 0.5                    | Sand<br>API 13B-1<br>Section 5                   |
| *When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40 °F when tested. |  |  |

Terragel or Novagel Polymer synthetic slurries shall be tested for conformance to the requirements shown in the following table:

| TERRAGEL OR NOVAGEL POLYMER<br>Geo-Tech Services, LLC   |  |  |
|---|--|--|
| PROPERTY  | REQUIREMENT  | TEST   |
| Density (pcf)<br><br>- during drilling<br><br>- before final cleaning<br>- just before placing concrete   | less than or equal to 67.0*<br><br><br><br>less than or equal to 64.0* | Mud Weight (Density)<br>API 13B-1<br>Section 1   |
| Viscosity (seconds/quart)<br><br>- during drilling<br><br>- before final cleaning<br>- just before placing concrete   | 45 to 104<br><br><br>less than or equal to 104                         | Marsh Funnel and Cup<br>API 13B-1<br>Section 2.2 |
| pH  | 6.0 to 11.5  | Glass Electrode pH Meter or pH Paper             |
| Sand Content (percent)<br><br>- before final cleaning<br>-just before placing concrete  | less than or equal to 0.5  | Sand<br>API 13B-1<br>Section 5                   |
| *When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40 °F when tested. |  |  |

### Water Slurry

At the option of the Contractor, water may be used as slurry when casing is used for the entire length of the drilled hole.

Water slurry shall be tested for conformance to the requirements shown in the following table:

| WATER SLURRY  |                           |  |
|---|---------------------------|--|
| PROPERTY  | REQUIREMENT               | TEST   |
| Density (pcf)<br><br>- before final cleaning<br>- just before placing concrete  | 63.5*                     | Mud Weight (Density)<br>API 13B-1<br>Section 1 |
| Sand Content (percent)<br><br>- before final cleaning<br>- just before placing concrete                                 | less than or equal to 0.5 | Sand<br>API 13B-1<br>Section 5                 |
| *When approved by the Engineer, salt water slurry may be used and the allowable densities may be increased up to 2 pcf. |                           |  |

## CONSTRUCTION

### General

CIDH concrete piling 24 inches in diameter or larger may be constructed by excavation and depositing concrete under slurry.

Portions of CIDH concrete piling shown on the plans to be formed shall be formed and finished in conformance with the provisions for concrete structures in Section 51, "Concrete Structures," of the Standard Specifications.

Unless otherwise shown on the plans, the bar reinforcing steel cage shall have at least 3 inches of clear cover measured from the outside of the cage to the sides of the hole or casing.

Spacers shall be placed at least 5 inches clear from any inspection tubes. Plastic spacers shall be placed around the circumference of the cage and at intervals along the length of the cage, as recommended by the manufacturer of the plastic spacer.

### Placing Concrete

Concrete deposited under slurry shall be carefully placed in a compact, monolithic mass and by a method that will prevent washing of the concrete. Concrete deposited under slurry need not be vibrated. Placing concrete shall be a continuous operation lasting not more than the time required for each concrete placing operation at each pile, as submitted in the placing plan, unless otherwise approved in writing by the Engineer. Concrete shall be placed with concrete pumps and delivery tube system of adequate number and size to complete the placing of concrete in the time specified. The delivery tube system shall consist of one of the following:

- A. A tremie tube or tubes, each of which are at least 10 inches in diameter, fed by one or more concrete pumps.
- B. One or more concrete pump tubes, each fed by a single concrete pump.

The delivery tube system shall consist of watertight tubes with sufficient rigidity to keep the ends always in the mass of concrete placed. If only one delivery tube is utilized to place the concrete, the tube shall be placed near the center of the drilled hole. Multiple tubes shall be uniformly spaced in the hole. Internal bracing for the steel reinforcing cage shall accommodate the delivery tube system. Tremies shall not be used for piles without space for a 10-inch tube.

Spillage of concrete into the slurry during concrete placing operations shall not be allowed. Delivery tubes shall be capped with a watertight cap, or plugged above the slurry level with a good quality, tight fitting, moving plug that will expel the slurry from the tube as the tube is charged with concrete. The cap or plug shall be designed to be released as the tube is charged. The pump discharge or tremie tube shall extend to the bottom of the hole before charging the tube with concrete. After charging the delivery tube system with concrete, the flow of concrete through

a tube shall be induced by slightly raising the discharge end. During concrete placement, the tip of the delivery tube shall be maintained as follows to prevent reentry of the slurry into the tube. Until at least 10 feet of concrete has been placed, the tip of the delivery tube shall be within 6 inches of the bottom of the drilled hole, and then the embedment of the tip shall be maintained at least 10 feet below the top surface of the concrete. Rapid raising or lowering of the delivery tube shall not be permitted. If the seal is lost or the delivery tube becomes plugged and must be removed, the tube shall be withdrawn, the tube cleaned, the tip of the tube capped to prevent entrance of the slurry, and the operation restarted by pushing the capped tube 10 feet into the concrete and then reinitiating the flow of concrete.

When slurry is used, a fully operational standby concrete pump, adequate to complete the work in the time specified, shall be provided at the site during concrete placement. The slurry level shall be maintained 10 feet above the piezometric head or within 12 inches of the top of the drilled hole, whichever is higher.

A log of concrete placement for each drilled hole shall be maintained by the Contractor when concrete is deposited under slurry. The log shall show the pile location, tip elevation, dates of excavation and concrete placement, total quantity of concrete deposited, length and tip elevation of any casing, and details of any hole stabilization method and materials used. The log shall include a 8-1/2" x 11" sized graph of the concrete placed versus depth of hole filled. The graph shall be plotted continuously throughout placing of concrete. The depth of drilled hole filled shall be plotted vertically with the pile tip oriented at the bottom and the quantity of concrete shall be plotted horizontally. Readings shall be made at least at each 5 feet of pile depth, and the time of the reading shall be indicated. The graph shall be labeled with the pile location, tip elevation, cutoff elevation, and the dates of excavation and concrete placement. The log shall be delivered to the Engineer within 1 working day of completion of placing concrete in the pile.

After placing reinforcement and before placing concrete in the drilled hole, if drill cuttings settle out of the slurry, the bottom of the drilled hole shall be cleaned. The Contractor shall verify that the bottom of the drilled hole is clean.

If a temporary casing is used, maintain concrete placed under slurry at a level at least 5 feet above the bottom of the casing. The equivalent hydrostatic pressure inside the casing must be greater than the hydrostatic pressure on the outside of the casing. The withdrawal of the casing must not cause contamination of the concrete with slurry.

Material resulting from using slurry shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

### **Acceptance Testing and Mitigation**

Vertical inspection pipes for acceptance testing shall be provided in all CIDH concrete piling 24 inches in diameter or larger, except when the holes are dry or when the holes are dewatered without the use of temporary casing in a manner that controls ground water.

The furnishing and placing of inspection pipes shall conform to the following:

- A. Inspection pipes shall be Schedule 40 PVC pipe conforming to ASTM D 1785 with a nominal pipe size of 2 inches. Watertight PVC couplers conforming to ASTM D 2466 are permitted to facilitate pipe lengths in excess of those which are commercially available. The Contractor shall log the location of the inspection pipe couplers with respect to the plane of pile cut off, and these logs shall be delivered to the Engineer upon completion of the placement of concrete in the drilled hole.
- B. Each inspection pipe shall be capped at the bottom and shall extend from 3 feet above the pile cutoff down to the bottom of the reinforcing cage. A temporary top cap or similar means shall be provided to keep the pipes clean before testing. If pile cutoff is below the ground surface or working platform, inspection pipes shall be extended to 3 feet above the ground surface or working platform. Approved covers or railings shall be provided and inspection pipes shall be located as necessary to minimize exposure of testing personnel to potential falling hazards.
- C. Inspection pipes shall be completely clean, dry, and unobstructed at the time of testing providing a 2-inch diameter clear opening.
- D. The inspection pipes shall be installed in straight alignment, parallel to the main reinforcement, and securely fastened in place to prevent misalignment during installation of the reinforcement and placing of concrete in the hole. The CIDH concrete piling shall be constructed so that the relative distance of inspection pipes to vertical steel reinforcement shall remain constant.
- E. When any changes are made to the tip of CIDH concrete piling, the Contractor shall also extend the inspection pipes to the bottom of the reinforcing cage.

The following additional requirements apply if inspection pipes are not shown on the plans:

- A. Inspection pipes shall be placed radially around the pile, inside the outermost spiral or hoop reinforcement and no more than 1 inch clear of the outermost spiral or hoop reinforcement.
- B. Inspection pipes shall be placed around the pile at a uniform spacing not exceeding 33 inches measured along the circle passing through the centers of inspection pipes. A minimum of 2 inspection pipes per pile shall be used. Inspection pipes shall be placed to provide the maximum diameter circle that passes through the centers of the inspection pipes while maintaining the spacing required herein.
- C. Inspection pipes shall be placed a minimum of 3 inches clear of the vertical reinforcement. When the vertical reinforcement configuration does not permit this clearance while achieving radial location requirements, distance to vertical rebar shall be maximized while still maintaining the requirement for radial location.
- D. Where the dimensions of the pile reinforcement do not permit inspection pipes to be placed per these requirements, a plan for tube placement shall be submitted to the Engineer for approval in the Pile Placement Plan with a request for deviation before fabricating pile reinforcement.

After placing concrete, inspection pipes shall be filled with water to prevent debonding of the pipe. Before requesting acceptance tests, each inspection pipe shall be tested by the Contractor in the presence of the Engineer by passing a 1-1/4-inch-diameter rigid cylinder 4.5 feet long through the length of pipe. If an inspection pipe fails to pass the 1-1/4-inch-diameter cylinder, the Contractor shall immediately fill all inspection pipes in the pile with water.

For each inspection pipe that does not pass the 1-1/4-inch-diameter cylinder, the Contractor shall core a nominal 2-inch diameter hole through the concrete for the entire length of the pile. Cored holes shall be located as close as possible to the inspection pipes they are replacing and shall be no more than 5 inches clear from the reinforcement.

Coring shall not damage the pile reinforcement. Cored holes shall be made with a double wall core barrel system utilizing a split tube type inner barrel. Coring with a solid type inner barrel will not be allowed. Coring methods and equipment shall provide intact cores for the entire length of the pile. The coring operation shall be logged by an Engineering Geologist or Civil Engineer licensed in the State of California and experienced in core logging. Coring logs shall be in conformance with the Department's "Soil and Rock Logging, Classification, and Presentation Manual." Coring logs shall include Core Recovery (REC), Rock Quality Designation (RQD), locations of breaks, and complete descriptions of inclusions and voids encountered during coring, and shall be delivered to the Engineer upon completion. Concrete cores shall be preserved, identified with the exact location the core was recovered from within the pile, and delivered to the Engineer upon completion. The Engineer will evaluate the portion of the pile represented by the cored hole based on the submitted core logs.

Acceptance tests of the concrete will be made by the Engineer, without cost to the Contractor. Acceptance tests will evaluate the homogeneity of the placed concrete. Tests will include gamma-gamma logging conducted in conformance with California Test 233. The Contractor shall not conduct operations within 25 feet of the gamma-gamma logging operations. The Contractor shall separate reinforcing steel as necessary to allow the Engineer access to the inspection pipes to perform gamma-gamma logging or other acceptance testing. After requesting acceptance tests and providing access to the piles, the Contractor shall allow 15 days for the Engineer to conduct these tests and make determination of acceptance.

If acceptance testing performed by the Engineer determines that a pile does not meet the requirements of the specifications and California Test 233, Part 5C, then that pile will be rejected and all depositing of concrete under slurry or concrete placed using temporary casing for the purpose of controlling groundwater shall be suspended until written changes to the methods of pile construction are approved in writing by the Engineer.

The Engineer will determine whether the rejected pile requires mitigation due to structural, geotechnical, or corrosion concerns. The Engineer will consider the estimated size and location of the anomaly and potential effects upon the design. The Engineer will provide the conclusions of this analysis to the Contractor for development of a mitigation plan, if required. The Contractor shall allow 30 days for the Engineer to determine whether the pile requires mitigation and provide information to the Contractor. Day 1 of the 30 days shall be the 1st day after access has been provided to the Engineer to perform acceptance testing. If the Contractor submits additional information to the Engineer that modifies the size, shape, or nature of the anomaly, the Contractor shall allow 10 additional days for the subsequent analysis.

The Engineer may elect to perform additional tests to further evaluate a rejected pile. These tests may include crosshole sonic logging and other means of inspection selected by the Engineer. The pile acceptance test report will indicate if the Department intends to perform any additional testing and when the testing will be performed. The Contractor shall allow the Department 20 additional days for a total of 50 days to perform these tests and to provide supplemental results. The Contractor may progress with the mitigation plan process without waiting for these supplemental results.

Inspection pipes and cored holes shall be dewatered and filled with grout after notification by the Engineer that the pile is acceptable. Grout shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the

Standard Specifications. Inspection pipes and holes shall be filled using grout tubes that extend to the bottom of the pipe or hole or into the grout already placed.

If a rejected pile does not require mitigation, the Contractor may repair the pile per an approved mitigation plan or the Department will deduct the amount shown in the table for each anomaly up to the maximum total deduction:

| Anomaly Location  | Anomaly Deduction |           |         |
|---|-------------------|-----------|---------|
|   | D < 4 feet        | 4 ≤ D < 6 | D ≥ 6   |
| Entirely or partially within the upper 2/3 of the pile length | \$1,000           | \$2,000   | \$4,000 |
| Entirely within the lower 1/3 of the pile length              | \$500             | \$1,000   | \$2,000 |
| Maximum total deduction                                       | \$2,000           | \$4,000   | \$8,000 |

Note:

D = Nominal pile diameter

The Department deducts the amount from any moneys due, or that may become due to the Contractor under the Contract.

If the Engineer determines that a rejected pile requires mitigation, the Contractor shall submit to the Engineer for approval a mitigation plan for repair, supplementation, or replacement for each rejected CIDH concrete pile conforming to the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. If the Engineer determines that it is not feasible to repair the rejected pile, the Contractor shall not include repair as a means of mitigation and shall proceed with the submittal of a mitigation plan for replacement or supplementation of the rejected pile.

If the Engineer determines it is not feasible to use one of ADSC's standard mitigation plans to mitigate the pile, the Contractor shall schedule a meeting and meet with the Engineer before submitting a nonstandard mitigation plan. The meeting attendees shall include the Contractor's representatives and the Engineer's representatives involved in the pile mitigation. The purpose of the meeting is to discuss the type of pile mitigation that would be acceptable to the Department. The Contractor shall provide the meeting facility. The Engineer will conduct the meeting.

Pile mitigation plans shall include the following:

- A. The designation and location of the pile addressed by the mitigation plan.
- B. A review of the structural, geotechnical, and corrosion design requirements of the rejected pile.
- C. A step by step description of the mitigation work to be performed, including drawings if necessary.
- D. An assessment of how the proposed mitigation work will address the structural, geotechnical, and corrosion design requirements of the rejected pile.
- E. Methods for preservation or restoration of existing earthen materials.
- F. A list of affected facilities, if any, with methods and equipment for protection of these facilities during mitigation.
- G. The State assigned contract number, bridge number, full name of the structure as shown on the contract plans, District-County-Route-Post Mile, and the Contractor's (and Subcontractor's if applicable) name on each sheet.
- H. A list of materials, with quantity estimates, and personnel, with qualifications, to be used to perform the mitigation work.
- I. The seal and signature of an engineer who is licensed as a Civil Engineer by the State of California. This requirement is waived for mitigation plans when either of the following conditions are present:
  1. The proposed mitigation will be performed in conformance with the most recent Department-published version of "ADSC Standard Mitigation Plan 'A' - Basic Repair" without exception or modification.
  2. The Engineer has determined that the rejected pile does not require mitigation due to structural, geotechnical, or corrosion concerns, and the Contractor elects to repair the pile using most recent Department-published version of "ADSC Standard Mitigation Plan 'B' - Grouting Repair" without exception or modification.

The most recent Department published version of the "ADSC Standard Mitigation Plan" is available at:

<http://www.dot.ca.gov/hq/esc/geotech/ft/adscmitplan.htm>

For rejected piles to be repaired, the Contractor shall submit a pile mitigation plan that contains the following additional information:

- A. An assessment of the nature and size of the anomalies in the rejected pile.
- B. Provisions for access for additional pile testing if required by the Engineer.

For rejected piles to be replaced or supplemented, the Contractor shall submit a pile mitigation plan that contains the following additional information:

- A. The proposed location and size of additional piles.
- B. Structural details and calculations for any modification to the structure to accommodate the replacement or supplemental piles.

All provisions for CIDH concrete piling shall apply to replacement piles.

The Contractor shall allow the Engineer 20 days to review the mitigation plan after a complete submittal has been received.

When repairs are performed, the Contractor shall submit a mitigation report to the Engineer within 10 days of completion of the repair. This report shall state exactly what repair work was performed and quantify the success of the repairs relative to the submitted mitigation plan. The mitigation report shall be stamped and signed by an engineer that is licensed as a Civil Engineer by the State of California. The mitigation report shall show the State assigned contract number, bridge number, full name of the structure as shown on the contract plans, District-County-Route-Post Mile, and the Contractor (and subcontractor if applicable) name on each sheet. The Engineer will be the sole judge as to whether a mitigation proposal is acceptable, the mitigation efforts are successful, and to whether additional repairs, removal and replacement, or construction of a supplemental foundation is required.

#### **MEASUREMENT AND PAYMENT (PILING)**

Measurement and payment for the various types and classes of piles shall conform to the provisions in Sections 49-6.01, "Measurement," and 49-6.02, "Payment," of the Standard Specifications and these special provisions.

Payment for cast-in-place concrete piling (except for sign and pole foundation piles) shall conform to the provisions in Section 49-6.02, "Payment," of the Standard Specifications and these special provisions.

Full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in drilling or coring holes, disposing of the material resulting from drilling or coring holes, furnishing and placing concrete, slurry, depositing concrete under slurry, test batches, inspection pipes, filling inspection holes and pipes with grout, drilling oversized cast-in-drilled-hole concrete piling, filling cave-ins and oversized piles with concrete, and redrilling through concrete shall be considered as included in the contract prices paid either per linear foot for cast-in-drilled-hole concrete piling of the types and sizes listed in the Engineer's Estimate, or per various contract items of electrical work, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, as directed by the Engineer, and no additional compensation will be allowed therefor.

#### **10-1.26 REINFORCEMENT**

Reinforcement shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications and these special provisions.

The provisions in "Welding Quality Control" of these special provisions do not apply to resistance butt welding.

#### **10-1.27 STEEL STRUCTURES**

Construction of steel structures shall conform to the provisions in Section 55, "Steel Structures," of the Standard Specifications and these special provisions.

Attention is directed to "Welding" in Section 8, "Materials," of these special provisions.

#### **MATERIALS**

High-strength fastener assemblies and other bolts attached to structural steel with nuts and washers shall be zinc coated. When direct tension indicators are used in these assemblies, the direct tension indicator and all components of the fastener assembly shall be zinc coated by the mechanical deposition process.

## ROTATIONAL CAPACITY TESTING PRIOR TO SHIPMENT TO JOB SITE

Rotational capacity tests shall be performed on all lots of high-strength fastener assemblies prior to shipment of these lots to the project site. Zinc-coated assemblies shall be tested after all fabrication, coating, and lubrication of components has been completed. One hardened washer shall be used under each nut for the tests.

The requirements of this section do not apply to high-strength cap screws or high-strength bolts used for slip base plates.

Each combination of bolt production lot, nut lot, and washer lot shall be tested as an assembly.

A rotational capacity lot number shall be assigned to each combination of lots tested. Each shipping unit of fastener assemblies shall be plainly marked with the rotational capacity lot number.

Two fastener assemblies from each rotational capacity lot shall be tested.

The following equipment, procedure, and acceptance criteria shall be used to perform rotational capacity tests on and determine acceptance of ASTM A 325 long bolts. Fasteners are considered to be long bolts when full nut thread engagement can be achieved when installed in a bolt tension measuring device:

### A. Long Bolt Test Equipment:

1. Calibrated bolt tension measuring device with adequate tension capacity for the bolts being tested.
2. Calibrated dial or digital torque wrench. Other suitable tools will be required for performing Steps 7 and 8 of the Long Bolt Test Procedure. A torque multiplier may be required for large diameter bolts.
3. Spacer washers or bushings. When spacer washers or bushings are required, they shall have the same inside diameter and equal or larger outside diameter as the appropriate hardened washers conforming to the requirements in ASTM Designation: F 436.
4. Steel beam or member, such as a girder flange or cross frame, to which the bolt tension measuring device will be attached. The device shall be accessible from the ground.

### B. Long Bolt Test Procedure:

1. Measure the bolt length. The bolt length is defined as the distance from the end of the threaded portion of the shank to the underside of the bolt head.
2. Install the nut on the bolt so that 3 to 5 full threads of the bolt are located between the bearing face of the nut and the underside of the bolt head. Measure and record the thread stickout of the bolt. Thread stickout is determined by measuring the distance from the outer face of the nut to the end of the threaded portion of the shank.
3. Insert the bolt into the bolt tension measuring device and install the required number of washers, and additional spacers as needed, directly beneath the nut to produce the thread stickout measured in Step 2 of this procedure.
4. Tighten the nut using a hand wrench to a snug-tight condition. The snug tension shall not be less than the Table A value but may exceed the Table A value by a maximum of 2 kips.

Table A

| High-Strength Fastener Assembly Tension Values to Approximate Snug-Tight Condition |                        |
|--|------------------------|
| Bolt Diameter<br>(inches)  | Snug Tension<br>(kips) |
| 1/2  | 1                      |
| 5/8  | 2                      |
| 3/4  | 3                      |
| 7/8  | 4                      |
| 1  | 5                      |
| 1-1/8  | 6                      |
| 1-1/4  | 7                      |
| 1-3/8  | 9                      |
| 1-1/2  | 10                     |

5. Match-mark the assembly by placing a heavy reference start line on the face plate of the bolt tension measuring device which aligns with (1) a mark placed on one corner of the nut and (2) a radial line placed across the flat on the end of the bolt or on the exposed portions of the threads of tension control bolts. Place an additional mark on the outside of the socket that overlays the mark on the nut



corner such that this mark will be visible while turning the nut. Make an additional mark on the face plate, either  $\frac{2}{3}$  of a turn, one turn, or  $1\frac{1}{3}$  turn clockwise from the heavy reference start line, depending on the bolt length being tested as shown in Table B.

Table B

| Required Nut Rotation for Rotational Capacity Tests <sup>(a) (b)</sup>           |                          |
|--|--------------------------|
| Bolt Length (measured in Step 1)   | Required Rotation (turn) |
| 4 bolt diameters or less   | $\frac{2}{3}$            |
| Greater than 4 bolt diameters but no more than 8 bolt diameters                  | 1                        |
| Greater than 8 bolt diameters, but no more than 12 bolt diameters <sup>(c)</sup> | $1\frac{1}{3}$           |

(a) Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by  $\frac{1}{2}$  turn and less, the tolerance shall be plus or minus 30 degrees; for bolts installed by  $\frac{2}{3}$  turn and more, the tolerance shall be plus or minus 45 degrees.

(b) Applicable only to connections in which all material within grip of the bolt is steel.

(c) When bolt length exceeds 12 diameters, the required rotation shall be determined by actual tests in a suitable tension device simulating the actual conditions.

6. Turn the nut to achieve the applicable minimum bolt tension value listed in Table C. After reaching this tension, record the moving torque, in foot-pounds, required to turn the nut, and also record the corresponding bolt tension value in pounds. Torque shall be measured with the nut in motion. Calculate the value, T, where  $T = [( \text{the measured tension in pounds} ) \times ( \text{the bolt diameter in inches} ) / 48]$ .

Table C

| Minimum Tension Values for High-Strength Fastener Assemblies |                        |
|--|------------------------|
| Bolt Diameter (inches)                                       | Minimum Tension (kips) |
| $\frac{1}{2}$  | 12                     |
| $\frac{5}{8}$  | 19                     |
| $\frac{3}{4}$  | 28                     |
| $\frac{7}{8}$  | 39                     |
| 1  | 51                     |
| $1\frac{1}{8}$   | 56                     |
| $1\frac{1}{4}$   | 71                     |
| $1\frac{3}{8}$   | 85                     |
| $1\frac{1}{2}$   | 103                    |

7. Turn the nut further to increase bolt tension until the rotation listed in Table B is reached. The rotation is measured from the heavy reference line made on the face plate after the bolt was snug-tight. Record this bolt tension.
8. Loosen and remove the nut and examine the threads on both the nut and bolt.

C. Long Bolt Acceptance Criteria:

1. An assembly shall pass the following requirements to be acceptable: (1) the measured moving torque (Step 6) shall be less than or equal to the calculated value, T (Step 6), (2) the bolt tension measured in Step 7 shall be greater than or equal to the applicable turn test tension value listed in Table D, (3) the nut shall be able to be removed from the bolt without signs of thread stripping or galling after the required rotation in Step 7 has been achieved, (4) the bolt does not shear from torsion or fail during the test, and (5) the assembly does not seize before the final rotation in Step 7 is reached. Elongation of the bolt in the threaded region between the bearing face of the nut and the underside of the bolt head is expected and will not be considered a failure. Both fastener assemblies tested from one rotational capacity lot shall pass for the rotational capacity lot to be acceptable.

Table D

| Turn Test Tension Values  |                             |
|---------------------------|-----------------------------|
| Bolt Diameter<br>(inches) | Turn Test Tension<br>(kips) |
| 1/2                       | 14                          |
| 5/8                       | 22                          |
| 3/4                       | 32                          |
| 7/8                       | 45                          |
| 1                         | 59                          |
| 1-1/8                     | 64                          |
| 1-1/4                     | 82                          |
| 1-3/8                     | 98                          |
| 1-1/2                     | 118                         |

The following equipment, procedure, and acceptance criteria shall be used to perform rotational capacity tests on and determine acceptance of ASTM A 325 short bolts. Fasteners are considered to be short bolts when full nut thread engagement cannot be achieved when installed in a bolt tension measuring device:

A. Short Bolt Test Equipment:

1. Calibrated dial or digital torque wrench. Other suitable tools will be required for performing Steps 7 and 8 of the Short Bolt Test Procedure. A torque multiplier may be required for large diameter bolts.
2. Spud wrench or equivalent.
3. Spacer washers or bushings. When spacer washers or bushings are required, they shall have the same inside diameter and equal or larger outside diameter as the appropriate hardened washers conforming to the requirements in ASTM Designation: F 436.
4. Steel plate or girder with a hole to install bolt. The hole size shall be 1/16 inch greater than the nominal diameter of the bolt to be tested. The grip length, including any plates, washers, and additional spacers as needed, shall provide the proper number of threads within the grip, as required in Step 2 of the Short Bolt Test Procedure.

B. Short Bolt Test Procedure:

1. Measure the bolt length. The bolt length is defined as the distance from the end of the threaded portion of the shank to the underside of the bolt head.
2. Install the nut on the bolt so that 3 to 5 full threads of the bolt are located between the bearing face of the nut and the underside of the bolt head. Measure and record the thread stickout of the bolt. Thread stickout is determined by measuring the distance from the outer face of the nut to the end of the threaded portion of the shank.
3. Install the bolt into a hole on the plate or girder and install the required number of washers and additional spacers as needed between the bearing face of the nut and the underside of the bolt head to produce the thread stickout measured in Step 2 of this procedure.
4. Tighten the nut using a hand wrench to a snug-tight condition. The snug condition shall be the full manual effort applied to the end of a 12-inch long wrench. This applied torque shall not exceed 20 percent of the maximum allowable torque in Table E.

Table E

| Maximum Allowable Torque for High-Strength Fastener Assemblies |                   |
|--|-------------------|
| Bolt Diameter<br>(inches)                                      | Torque<br>(ft-lb) |
| 1/2  | 145               |
| 5/8  | 285               |
| 3/4  | 500               |
| 7/8  | 820               |
| 1  | 1220              |
| 1-1/8  | 1500              |
| 1-1/4  | 2130              |
| 1-3/8  | 2800              |
| 1-1/2  | 3700              |

5. Match-mark the assembly by placing a heavy reference start line on the steel plate or girder which aligns with (1) a mark placed on one corner of the nut and (2) a radial line placed across the flat on the end of the bolt or on the exposed portions of the threads of tension control bolts. Place an additional mark on the outside of the socket that overlays the mark on the nut corner such that this mark will be visible while turning the nut. Make 2 additional small marks on the steel plate or girder, one 1/3 of a turn and one 2/3 of a turn clockwise from the heavy reference start line on the steel plate or girder.
6. Using the torque wrench, tighten the nut to the rotation value listed in Table F. The rotation is measured from the heavy reference line described in Step 5 made after the bolt was snug-tight. A second wrench shall be used to prevent rotation of the bolt head during tightening. Measure and record the moving torque after this rotation has been reached. The torque shall be measured with the nut in motion.

Table F

| Nut Rotation Required for Turn-of-Nut Installation <sup>(a),(b)</sup> |                          |
|---|--------------------------|
| Bolt Length (measured in Step 1)                                      | Required Rotation (turn) |
| 4 bolt diameters or less  | 1/3                      |

(a) Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance shall be plus or minus 30 degrees.

(b) Applicable only to connections in which all material within grip of the bolt is steel.

7. Tighten the nut further to the 2/3-turn mark as indicated in Table G. The rotation is measured from the heavy reference start line made on the plate or girder when the bolt was snug-tight. Verify that the radial line on the bolt end or on the exposed portions of the threads of tension control bolts is still in alignment with the start line.

Table G

| Required Nut Rotation for Rotational Capacity Test |                          |
|--|--------------------------|
| Bolt Length (measured in Step 1)                   | Required Rotation (turn) |
| 4 bolt diameters or less                           | 2/3                      |

8. Loosen and remove the nut and examine the threads on both the nut and bolt.

### C. Short Bolt Acceptance Criteria:

1. An assembly shall pass the following requirements to be acceptable: (1) the measured moving torque from Step 6 shall be less than or equal to the maximum allowable torque from Table E, (2) the nut shall be able to be removed from the bolt without signs of thread stripping or galling after the required rotation in Step 7 has been achieved, (3) the bolt does not shear from torsion or fail during the test, and (4) the assembly shall not seize before the final rotation in Step 7 is reached. Elongation of the bolt in the threaded region between the bearing face of the nut and the underside of the bolt head will not be considered a failure. Both fastener assemblies tested from one rotational capacity lot shall pass for the rotational capacity lot to be acceptable.

### **INSTALLATION TENSION TESTING AND ROTATIONAL CAPACITY TESTING AFTER ARRIVAL ON THE JOB SITE**

Installation tension tests and rotational capacity tests on high-strength fastener assemblies shall be performed by the Contractor prior to acceptance or installation and after arrival of the fastener assemblies on the project site. Installation tension tests and rotational capacity tests shall be performed at the job site, in the presence of the Engineer, on each rotational capacity lot of fastener assemblies.

The requirements of this section do not apply to high-strength cap screws or high-strength bolts used for slip base plates.

Installation tension tests shall be performed on 3 representative fastener assemblies in conformance with the provisions in Section 8, "Installation," of the RCSC Specification. For short bolts, Section 8.2, "Pretensioned Joints," of the RCSC Specification shall be replaced by the "Pre-Installation Testing Procedures," of the "Structural Bolting Handbook," published by the Steel Structures Technology Center, Incorporated.

The rotational capacity tests shall be performed in conformance with the requirements for rotational capacity tests in "Rotational Capacity Testing Prior to Shipment to Job Site" of these special provisions.

At the Contractor's expense, additional installation tension tests, tests required to determine job inspecting torque, and rotational capacity tests shall be performed by the Contractor on each rotational capacity lot, in the presence of the Engineer, if:

1. Any fastener is not used within 3 months after arrival on the job site,
2. Fasteners are improperly handled, stored, or subjected to inclement weather prior to final tightening,
3. Significant changes are noted in original surface condition of threads, washers, or nut lubricant, or
4. The Contractor's required inspection is not performed within 48 hours after all fasteners in a joint have been tensioned.

Failure of a job-site installation tension test or a rotational capacity test will be cause for rejection of unused fasteners that are part of the rotational capacity lot.

When direct tension indicators are used, installation verification tests shall be performed in conformance with Appendix Section X1.4 of ASTM Designation: F 959, except that bolts shall be initially tensioned to a value 5 percent greater than the minimum required bolt tension.

### **SURFACE PREPARATION**

For all bolted connections, the new contact surfaces shall be cleaned and coated before assembly in conformance with the provisions for cleaning and painting structural steel of these special provisions.

### **SEALING**

When zinc-coated tension control bolts are used, the sheared end of each fastener shall be completely sealed with non-silicone type sealing compound conforming to the requirements in ASTM Designation: C 920. The sealant shall be gray in color and shall have a minimum thickness of 50 mils. The sealant shall be applied to a clean sheared surface on the same day that the splined end is sheared off.

## WELDING

Table 2.2 of AWS D1.5 is superseded by the following table:

| Base Metal Thickness of the Thicker Part Joined, inches | Minimum Effective Partial Joint Penetration Groove Weld Size*, inches |
|---|---|
| Over 1/4 to 1/2 inclusive                               | 3/16  |
| Over 1/2 to 3/4 inclusive                               | 1/4   |
| Over 3/4 to 1-1/2 inclusive                             | 5/16  |
| Over 1-1/2 to 2-1/4 inclusive                           | 3/8   |
| Over 2-1/4 to 6 inclusive                               | 1/2   |
| Over 6  | 5/8   |

\* Except the weld size need not exceed the thickness of the thinner part

Dimensional details and workmanship for welded joints in tubular and pipe connections shall conform to the provisions in Part A, "Common Requirements of Nontubular and Tubular Connections," and Part D, "Specific Requirements for Tubular Connections," in Section 2 of AWS D1.1.

The requirement of conformance with AWS D1.5 shall not apply to work conforming to Section 56-1, "Overhead Sign Structures," or Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications.

### 10-1.28 ROADSIDE SIGNS

Roadside signs shall be furnished and installed at the locations shown on the plans or where designated by the Engineer and in conformance with the provisions in Section 56-2, "Roadside Signs," of the Standard Specifications and these special provisions.

The Contractor shall furnish roadside sign panels in conformance with the provisions in "Furnish Sign" of these special provisions.

Wood posts shall be pressure treated after fabrication in conformance with the provisions in Section 58, "Preservative Treatment of Lumber, Timber and Piling," of the Standard Specifications and AWP A Use Category System: UC4A, Commodity Specification A or B.

### 10-1.29 FURNISH SIGN

Signs shall be fabricated and furnished in accordance with details shown on the plans, the Traffic Sign Specifications, and these special provisions.

Traffic Sign Specifications for California sign codes are available for review at:

<http://www.dot.ca.gov/hq/traffops/signtech/signdel/specs.htm>

Traffic Sign Specifications for signs referenced with Federal MUTCD sign codes can be found in Standard Highway Signs Book, administered by the Federal Highway Administration, which is available for review at:

[http://mutcd.fhwa.dot.gov/ser-shs\\_millennium.htm](http://mutcd.fhwa.dot.gov/ser-shs_millennium.htm)

Information on cross-referencing California sign codes with the Federal MUTCD sign codes is available at:

<http://www.dot.ca.gov/hq/traffops/signtech/signdel/specs.htm>

Temporary or permanent signs shall be free from blemishes that may affect the serviceability and detract from the general sign color and appearance when viewing during daytime and nighttime from a distance of 25 feet. The face of each finished sign shall be uniform, flat, smooth, and free of defects, scratches, wrinkles, gel, hard spots, streaks, extrusion marks, and air bubbles. The front, back, and edges of the sign panels shall be free of router chatter marks, burns, sharp edges, loose rivets, delaminated skins, excessive adhesive over spray and aluminum marks.

### QUALITY CONTROL FOR SIGNS

The requirements of "Quality Control for Signs" in this section shall not apply to construction area signs.

No later than 14 days before sign fabrication, the Contractor shall submit a written copy of the quality control plan for signs to the Engineer for review. The Engineer will have 10 days to review the quality control plan. Sign fabrication shall not begin until the Engineer approves the Contractor's quality control plan in writing. The

Contractor shall submit to the Engineer at least 3 copies of the approved quality control plan. The quality control plan shall include, but not be limited to the following requirements:

- A. Identification of the party responsible for quality control of signs,
- B. Basis of acceptance for incoming raw materials at the fabrication facility,
- C. Type, method and frequency of quality control testing at the fabrication facility,
- D. List (by manufacturer and product name) of process colors, protective overlay film, retroreflective sheeting and black non-reflective film,
- E. Recommended cleaning procedure for each product, and
- F. Method of packaging, transport and storage for signs.

No legend shall be installed at the project site. Legend shall include letters, numerals, tildes, bars, arrows, route shields, symbols, logos, borders, artwork, and miscellaneous characters. The style, font, size, and spacing of the legend shall conform to the Standard Alphabets published in the FHWA Standard Highway Signs Book. The legend shall be oriented in the same direction in accordance with the manufacturer's orientation marks found on the retroreflective sheeting.

On multiple panel signs, legend shall be placed across joints without affecting the size, shape, spacing, and appearance of the legend. Background and legend shall be wrapped around interior edges of formed panel signs as shown on plans to prevent delamination.

The following notation shall be placed on the lower right side of the back of each sign where the notation will not be blocked by the sign post or frame:

- A. PROPERTY OF STATE OF CALIFORNIA,
- B. Name of the sign manufacturer,
- C. Month and year of fabrication,
- D. Type of retroreflective sheeting, and
- E. Manufacturer's identification and lot number of retroreflective sheeting.

The above notation shall be applied directly to the aluminum sign panels in 1/4-inch upper case letters and numerals by die-stamp and applied by similar method to the fiberglass reinforced plastic signs. Painting, screening, or engraving the notation will not be allowed. The notation shall be applied without damaging the finish of the sign.

Signs with a protective overlay film shall be marked with a dot of 3/8 inch in diameter. The dot placed on white border shall be black, while the dot placed on black border shall be white. The dot shall be placed on the lower border of the sign before application of the protective overlay film and shall not be placed over the legend and bolt holes. The application method and exact location of the dot shall be determined by the manufacturer of the signs.

For sign panels that have a minor dimension of 48 inches or less, no splice will be allowed in the retroreflective sheet except for the splice produced during the manufacturing of the retroreflective sheeting. For sign panels that have a minor dimension greater than 48 inches, only one horizontal splice will be allowed in the retroreflective sheeting.

Unless specified by the manufacturer of the retroreflective sheeting, splices in retroreflective sheeting shall overlap by a minimum of one inch. Splices shall not be placed within 2 inches from edges of the panels. Except at the horizontal borders, the splices shall overlap in the direction from top to bottom of the sign to prevent moisture penetration. The retroreflective sheeting at the overlap shall not exhibit a color difference under the incident and reflected light.

Signs exhibiting a significant color difference between daytime and nighttime shall be replaced immediately.

Repairing sign panels will not be allowed except when approved by the Engineer.

The Department will inspect signs at the Contractor's facility and delivery location, and in accordance with Section 6, "Control of Materials," of the Standard Specifications. The Engineer will inspect signs for damage and defects before and after installation.

Regardless of kind, size, type, or whether delivered by the Contractor or by a common carrier, signs shall be protected by thorough wrapping, tarping, or other methods to ensure that signs are not damaged by weather conditions and during transit. Signs shall be dry during transit and shipped on pallets, in crates, or tier racks. Padding and protective materials shall be placed between signs as appropriate. Finished sign panels shall be transported and stored by method that protects the face of signs from damage. The Contractor shall replace wet, damaged, and defective signs.

Signs shall be stored in dry environment at all times. Signs shall not rest directly on the ground or become wet during storage. Signs, whether stored indoor or outdoor, shall be free standing. In areas of high heat and humidity signs shall be stored in enclosed climate-controlled trailers or containers. Signs shall be stored indoor if duration of the storage will exceed 30 days.

Screen processed signs shall be protected, transported and stored as recommended by the manufacturer of the retroreflective sheeting.

When requested, the Contractor shall provide the Engineer test samples of signs and materials used at various stages of production. Sign samples shall be 12" x 12" in size with applied background, letter or numeral, and border strip.

The Contractor shall assume the costs and responsibilities resulting from the use of patented materials, equipment, devices, and processes for the Contractor's work.

### **SHEET ALUMINUM**

Alloy and temper designations for sheet aluminum shall be in accordance with ASTM Designation: B 209.

The Contractor shall furnish the Engineer a Certificate of Compliance in conformance with Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for the sheet aluminum.

Sheet aluminum shall be pretreated in accordance to ASTM Designation: B 449. Surface of the sheet aluminum shall be cleaned, deoxidized, and coated with a light and tightly adherent chromate conversion coating free of powdery residue. The conversion coating shall be Class 2 with a weight between 10 milligrams per square foot and 35 milligrams per square foot, and an average weight of 25 milligrams per square foot. Following the cleaning and coating process, the sheet aluminum shall be protected from exposure to grease, oils, dust, and contaminants.

Sheet aluminum shall be free of buckles, warps, dents, cockles, burrs, and defects resulting from fabrication.

Base plate for standard route marker shall be die cut.

### **RETROREFLECTIVE SHEETING**

The Contractor shall furnish retroreflective sheeting for sign background and legend in conformance with ASTM Designation: D 4956 and "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

Retroreflective sheeting shall be applied to sign panels as recommended by the retroreflective sheeting manufacturer without stretching, tearing, and damage.

Class 1, 3, or 4 adhesive backing shall be used for Type II, III, IV, VII, VIII, and IX retroreflective sheeting. Class 2 adhesive backing may also be used for Type II retroreflective sheeting. The adhesive backing shall be pressure sensitive and fungus resistant.

When the color of the retroreflective sheeting determined from instrumental testing is in dispute, the Engineer's visual test will govern.

### **PROCESS COLOR AND FILM**

The Contractor shall furnish and apply screened process color, non-reflective opaque black film, and protective overlay film of the type, kind, and product that are approved by the manufacturer of the retroreflective sheeting.

The Contractor shall furnish the Engineer a Certificate of Compliance in accordance to Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for the screened process color, non-reflective opaque black film, and protective overlay film.

The surface of the screened process color shall be flat and smooth. When the screened process colors determined from the instrumental testing in accordance to ASTM Designation: D 4956 are in dispute, the Engineer's visual test will govern.

The Contractor shall provide patterns, layouts, and set-ups necessary for the screened process.

The Contractor may use green, red, blue, and brown reverse-screened process colors for background and non-reflective opaque black film or black screened process color for legend. The coefficient of retroreflection for reverse-screened process colors on white retroreflective sheeting shall not be less than 70 percent of the coefficient of retroreflection specified in ASTM Designation: D 4956.

The screened process colors and non-reflective opaque black film shall have the same outdoor weatherability as that of the retroreflective sheeting.

After curing, screened process colors shall withstand removal when tested by applying 3M Company Scotch Brand Cellophane Tape No. 600 or equivalent tape over the color and removing with one quick motion at 90° angle.

### **SINGLE SHEET ALUMINUM SIGN**

Single sheet aluminum signs shall be fabricated and furnished with or without frame. The Contractor shall furnish the sheet aluminum in accordance to "Sheet Aluminum" of these special provisions. Single sheet aluminum signs shall be fabricated from sheet aluminum alloy 6061-T6 or 5052-H38.

Single sheet aluminum signs shall not have a vertical splice in the sheet aluminum. For signs with depth greater than 48 inches, one horizontal splice will be allowed in the sheet aluminum.

Framing for single sheet aluminum signs shall consist of aluminum channel or rectangular aluminum tubing. The framing shall have a length tolerance of  $\pm 1/8$  inch. The face sheet shall be affixed to the frame with rivets of 3/16-inch diameter. Rivets shall be placed within the web of channels and shall not be placed less than 1/2 inch from edges of the sign panels. Rivets shall be made of aluminum alloy 5052 and shall be anodized or treated with conversion coating to prevent corrosion. The exposed portion of rivets on the face of signs shall be the same color as the background or legend where the rivets are placed.

Finished signs shall be flat within a tolerance of  $\pm 1/32$  inch per linear foot when measured across the plane of the sign in all directions. The finished signs shall have an overall tolerance within  $\pm 1/8$  inch of the detailed dimensions.

Aluminum channels or rectangular aluminum tubings shall be welded together with the inert gas shielded-arc welding process using E4043 aluminum electrode filler wires as shown on the plans. Width of the filler shall be equal to wall thickness of smallest welded channel or tubing.

### **FIBERGLASS REINFORCED PLASTIC PANEL SIGN**

The Contractor shall furnish fiberglass reinforced plastic panel sign in accordance with ASTM Designation: D 3841 and "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

Fiberglass reinforced plastic shall be acrylic modified and ultraviolet stabilized for outdoor weatherability. The plastic shall contain additives designed to suppress fire ignition and flame propagation. When tested in accordance with the requirements in the ASTM Designation: D 635, the extent of burning shall not exceed one inch.

Fiberglass reinforced plastic shall be stabilized to prevent the release solvents and monomers. The front and back surfaces of the laminate shall be clean and free of constituents and releasing agents that can interfere with the bonding of retroreflective sheeting.

The fiberglass reinforced plastic panel sign shall be weather resistant Grade II thermoset polyester laminate.

The fiberglass reinforced plastic panels shall be minimum 0.135-inch thick. Finished fiberglass reinforced plastic panel signs shall be flat within a tolerance of  $\pm 1/32$  inch per linear foot when measured across the plane of the sign in all directions. The finished signs shall have an overall tolerance within  $\pm 1/8$  inch of the specified dimensions.

Color of fiberglass reinforced plastic panels shall be uniform gray within Munsel color range of N7.5 to N8.5.

Fiberglass reinforced plastic panels shall be cut from a single piece of laminate. Bolt holes shall be predrilled. The predrilled bolt holes, panel edges, and the front and back surfaces of the panels shall be true and smooth. The panel surfaces shall be free of visible cracks, pinholes, foreign inclusions, warping and wrinkles that can affect performance and serviceability.

### **MEASUREMENT AND PAYMENT**

Furnishing signs (except for construction area signs) will be measured by the square foot and the quantity to be paid for will be the total area, in square feet, of the sign panel types installed in place.

The contract price paid per square foot for furnish sign of the types specified in the Engineer's estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in fabricating and furnishing the signs, including fastening hardware, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for furnishing and installing protective overlay on signs shall be considered as included in the contract price paid per square foot for furnish sign of the various types and no separate payment will be made therefor.

### **10-1.30 MARKERS AND DELINEATORS**

Markers and delineators shall conform to the provisions in Section 82, "Markers and Delineators," of the Standard Specifications and these special provisions.

Markers and delineators on flexible posts shall conform to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions. Flexible posts shall be made from a flexible white plastic which shall be resistant to impact, ultraviolet light, ozone, and hydrocarbons. Flexible posts shall resist stiffening with age and shall be free of burns, discoloration, contamination, and other objectionable marks or defects which affect appearance or serviceability.

Retroreflective sheeting for metal and flexible target plates shall be the retroreflective sheeting designated for channelizers, markers, and delineators conforming to the requirements in ASTM Designation: D 4956-95 and in conformance with the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions.



### **10-1.31 METAL BEAM GUARD RAILING**

Metal beam guard railing shall be constructed in conformance with the provisions in Section 83-1, "Railings," of the Standard Specifications and these special provisions.

Attention is directed to "Order of Work" of these special provisions.

Line posts shall be wood, steel, or plastic. Blocks shall be wood or plastic.

### **ALTERNATIVE FLARED TERMINAL SYSTEM**

Alternative flared terminal system shall be furnished and installed as shown on the plans and in conformance with these special provisions.

The allowable alternatives for a flared terminal system shall consist of one of the following or a Department approved equal.

- A. **TERMINAL SYSTEM (TYPE FLEAT)** - Terminal system (Type FLEAT) shall be a Flared Energy Absorbing Terminal 350 manufactured by Road Systems, Inc., located in Big Spring, Texas, and shall include items detailed for terminal system (Type FLEAT) shown on the plans. The Flared Energy Absorbing Terminal 350 can be obtained from the distributor, Universal Industrial Sales, P.O. Box 699, Pleasant Grove, UT 84062, telephone (801) 785-0505 or from the distributor, Gregory Highway Products, 4100 13<sup>th</sup> Street, S.W., Canton, OH 44708, telephone (330) 477-4800.
- B. **TERMINAL SYSTEM (TYPE SRT)** - Terminal system (Type SRT) shall be an SRT-350 Slotted Rail Terminal (8-post system) as manufactured by Trinity Industries, Inc., and shall include items detailed for terminal system (Type SRT) shown on the plans. The SRT-350 Slotted Rail Terminal (8-post system) can be obtained from the manufacturer, Trinity Industries, Inc., P.O. Box 99, 950 West 400S, Centerville, UT 84014, telephone (800) 772-7976.

The Contractor shall provide the Engineer with a Certificate of Compliance from the manufacturer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The Certificate of Compliance shall certify that the terminal systems furnished conform to the contract plans and specifications, conform to the prequalified design and material requirements, and were manufactured in conformance with the approved quality control program.

Terminal systems shall be installed in conformance with the manufacturer's installation instructions and these requirements. Each terminal system installed shall be identified by painting the type of terminal system in neat black letters and figures 2 inches high on the backside of the rail element between system posts numbers 4 and 5.

For terminal system (Type SRT), the steel foundation tubes with soil plates attached shall be, at the Contractor's option, either driven, with or without pilot holes, or placed in drilled holes. Space around the steel foundation tubes shall be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer shall be moistened and thoroughly compacted. The wood terminal posts shall be inserted into the steel foundation tubes by hand and shall not be driven. Before the wood terminal posts are inserted, the inside surfaces of the steel foundation tubes to receive the wood posts shall be coated with a grease which will not melt or run at a temperature of 149 °F or less. The edges of the wood terminal posts may be slightly rounded to facilitate insertion of the post into the steel foundation tubes.

For terminal system (Type FLEAT), the soil tubes shall be, at the Contractor's option, driven with or without pilot holes, or placed in drilled holes. Space around the steel foundation tubes shall be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer shall be moistened and thoroughly compacted. Wood posts shall be inserted into the steel foundation tubes by hand. Before the wood terminal posts are inserted, the inside surfaces of the steel foundation tubes to receive the wood posts shall be coated with a grease which will not melt or run at a temperature of 149 °F or less. The edges of the wood posts may be slightly rounded to facilitate insertion of the post into the steel foundation tubes.

Surplus excavated material remaining after the terminal system has been installed shall be disposed of in a uniform manner along the adjacent roadway where designated by the Engineer.

The contract unit price paid for alternative flared terminal system shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing alternative flared terminal system, complete in place, including excavation, backfill and disposal of surplus material, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

### **10-1.32 VEGETATION CONTROL (MINOR CONCRETE)**

This work shall consist of furnishing and constructing vegetation control as specified in these special provisions, as shown on the plans and as directed by the Engineer.

#### **MATERIALS**

##### **Minor Concrete**

Concrete for vegetation control shall consist of a mixture of portland cement concrete, crumb rubber and concrete reinforcing fibers. Concrete shall conform to the provisions for minor concrete in Section 90, "Portland Cement Concrete," of the Standard Specifications and these special provisions. Components of the concrete for vegetation control shall be incorporated homogeneously at the concrete plant before delivery to the work site.

Reinforcing fibers for minor concrete shall consist of polypropylene fibers with an engineered sinusoidal contoured profile, manufactured specifically for use as concrete reinforcement. Reinforcing fiber shall consist of a blended ratio of 4 parts of coarse monofilament fibers with maximum individual fiber lengths of 2-inch  $\pm$  1/2-inch and 1 part of fine fibrillated polypropylene fibers of various lengths and thickness. Reinforcing fibers shall be of a commercial source, combined with the concrete in proportions as recommended by the manufacturer.

##### **Grout**

Grout for vegetation control shall conform to the provisions in Section 19-3.062, "Slurry Cement Backfill," of the Standard Specifications and these special provisions.

Not more than 188 pounds of cement shall be used for each cubic yard of material produced.

Aggregate for grout shall be commercial quality concrete sand.

##### **Landscape Fabric**

Landscape fabric shall be manufactured from thermally spun bonded polypropylene fabric and shall conform to the following:

| Specification         | Minimum Requirement      |
|-----------------------|--------------------------|
| Grab Tensile Strength | 135 lb                   |
| Grab Elongation       | 70%                      |
| UV Resistance         | 70% @ 150 hours          |
| Weight                | 3 ounces per square yard |

Staples for landscape fabric shall be 2 inches in width, 6 inches in length and 11-gauge wire.

A copy of the manufacturer's product sheet, together with instructions for installation, shall be furnished to the Engineer 5 business days before installation.

A Certificate of Compliance for the landscape fabric shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

#### **SITE PREPARATION**

##### **Clearing**

Areas to receive vegetation control shall be cleared of trash and debris in conformance with Section 16, "Clearing and Grubbing," of the Standard Specifications and these special provisions.

Vegetation shall be removed to the ground. Cleared trash, debris and removed vegetation shall be disposed of outside the highway right of way in conformance with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

##### **Earthwork**

Earthwork shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications and these special provisions.

After clearing, areas to receive vegetation control shall be excavated. Where vegetation control abuts the existing surfacing, the edge of the existing surfacing shall be on a neat line or shall be cut on a neat line to a minimum depth of 0.17-foot before removing the surfacing. The area to receive vegetation control shall be excavated to maintain planned flow lines, slope gradient and contours of the project site.

After excavation, areas to receive vegetation control shall be graded to a smooth, uniform surface and compacted to a relative compaction of not less than 90 percent.

Attention is directed to "Material Containing Aerially Deposited Lead" of these special provisions regarding the handling and disposal of soil containing aerially deposited lead.

### **PLACEMENT**

Landscape fabric shall be stapled to prevent shifting during concrete placement. Fabric shall lie flat, smooth, without bulges or wrinkles, and maintain uniform contact with the soil surface.

Grout shall be spread to completely fill voids as shown on the plans.

Minor concrete shall be struck off and compacted until a layer of mortar has been brought to the surface. Minor concrete shall receive a broom finish.

Two weakened plane joints shall be constructed in the minor concrete at each post location, perpendicular to the rail and in line with the edge of the grout. The joints shall be constructed to a minimum depth of one inch by scoring with a tool that will leave the corners rounded and ensure free movement of concrete at the joint.

The finished grade of vegetation control shall be uniform; maintaining planned flow lines, slope gradient and contours of the project site.

### **MEASUREMENT AND PAYMENT**

Quantities of vegetation control (minor concrete) will be measured by the square yard computed from measurements of actual areas placed. Vegetation control (minor concrete) placed outside the dimensions shown on the plans will not be paid for.

The contract price paid per square yard for vegetation control (minor concrete) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing vegetation control (minor concrete), including clearing trash, debris and vegetation and excavation, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

## **SECTION 10-2. (BLANK)**

## **SECTION 10-3. ELECTRICAL SYSTEMS**

### **10-3.01 DESCRIPTION**

Traffic operations system, fiber optic system, microwave vehicle detection system, aggregation Ethernet switch, edge Ethernet switch, signal interconnect network element, closed circuit television camera units, video encoder unit, camera control unit, informational message sign assembly, arterial dynamic message sign panel and assembly, system testing and documentation, San Mateo hub, and maintaining existing traffic management system elements during construction shall conform to the provisions in Section 86, "Electrical Systems," of the Standard Specifications and these special provisions.

Traffic operations system shall consist of:

1. Camera station
2. Model 334T cabinet
3. Traffic operations system equipment testing
4. Sign control cable
5. Telephone cable
6. Sign structures for arterial dynamic message sign and informational message sign

### **10-3.02 COST BREAK-DOWN**

Cost break-downs shall conform to the provisions in Section 86-1.03, "Cost Break-Down," of the Standard Specifications and these special provisions.

The Engineer shall be furnished a cost break-down for each contract lump sum item of work described in this Section 10-3.

The cost break-down shall be submitted to the Engineer for approval within 15 days after the contract has been approved. The cost break-down shall be approved, in writing, by the Engineer before any partial payment for the items of electrical work will be made.

The cost break-down shall include the following items in addition to those listed in the Standard Specifications:

1. Fiber optic cable of various types
2. Innerduct

3. Fiber patch panel
4. Fiber pull box
5. Fiber splice enclosure
6. Hybrid camera cable
7. IMS interface cable
8. Fiber distribution unit of various types
9. Multiple camera termination unit
10. Network straight through data cable
11. Video detection cable
12. Model 334T cabinet
13. Arterial dynamic message sign and informational message sign structures
14. FFORS
15. FFOTS
16. SFP fiber transceivers
17. Backup signal system server

### **10-3.03 MAINTAINING EXISTING AND TEMPORARY ELECTRICAL SYSTEMS**

Traffic signal system shutdowns shall be limited to periods allowed for lane closures listed or specified in "Maintaining Traffic" of these special provisions.

### **10-3.04 MAINTAINING EXISTING TRAFFIC MANAGEMENT SYSTEM ELEMENTS DURING CONSTRUCTION**

Traffic Management System (TMS) elements include, but are not limited to ramp metering (RM) system, communication system, traffic monitoring stations, video image vehicle detection system (VIVDS), microwave vehicle detection system (MVDS), loop detection system, changeable message sign (CMS) system, extinguishable message sign (EMS) system, highway advisory radio (HAR) system, closed circuit television (CCTV) camera system, roadway weather information system (RWIS), visibility sensor, and fiber optic system.

Existing TMS elements, including detection systems, identified on the plans and located within the project limits shall remain in place and be protected from damage. If the construction activities require existing TMS elements to be nonoperational or off line, and if temporary or portable TMS elements are not shown on the plans, the Contractor shall provide for temporary or portable TMS elements. The Contractor shall receive the Engineer's approval on the type of temporary or portable TMS elements and installation method.

Before work is performed, the Engineer, the Contractor, and the Department's Traffic Operations Electrical representatives shall jointly conduct a pre-construction operational status check of all existing TMS elements and each element's communication status with the Traffic Management Center (TMC), including existing TMS elements that are not shown on the plans and elements that may not be impacted by the Contractor's activities. The Department's Traffic Operations Electrical representatives will certify the TMS elements' location and status, and provide a copy of the certified list of the existing TMS elements within the project limits to the Contractor. The status list will include the operational, defined as having full functionality, and the nonoperational components.

The Contractor shall obtain written approval from the Engineer at least 72 hours before interrupting existing TMS elements' communication with the TMC that will result in the elements being nonoperational or off line. The Contractor shall notify the Engineer at least 72 hours before starting excavation activities.

Traffic monitoring stations and their associated communication systems, which were verified to be operational during the pre-construction operational status check, shall remain operational on freeway/highway mainline at all times, except:

1. For a duration of up to 15 days on any continuous segment of the freeway/highway longer than 3 miles
2. For a duration of up to 60 days on any continuous segment of the freeway/highway shorter than 3 miles

If the construction activities require existing detection systems to be nonoperational or off line for a longer time period or the spacing between traffic monitoring stations is more than the specified criteria above, and temporary or portable detection operations are not shown on the plans, the Contractor shall provide provisions for temporary or portable detection operations. The Contractor shall receive the Engineer's approval on the type of detection and installation before installing the temporary or portable detection.

If existing TMS elements shown on the plans or identified during the pre-construction operational status check, except traffic monitoring stations, are damaged or fail due to the Contractor's activity, where the elements are not fully functional, the Engineer shall be notified immediately. If the Contractor is notified by the Engineer that existing TMS elements have been damaged, have failed or are not fully functional due to the Contractor's activity,

the damaged or failed TMS elements, excluding structure-related elements, shall be repaired or replaced, at the Contractor's expense, within 24 hours. For a structure-related elements, the Contractor shall install temporary or portable TMS elements within 24 hours. For nonstructure-related TMS elements, the Engineer may approve temporary or portable TMS elements for use during the construction activities.

If fiber optic cables are damaged due to the Contractor's activities, the Contractor shall install new fiber optic cables from an original splice point or termination to an original splice point or termination, unless otherwise authorized in writing by the Engineer. Fiber optic cable shall be spliced at the splice vaults if available. The amount of new fiber optic cable slack in splice vaults and the number of new fiber optic cable splices shall be equivalent to the amount of slack and number of splices existing before the damage or as directed by the Engineer. Fusion splicing will be required.

The Contractor shall demonstrate that repaired or replaced elements operate in a manner equal to or better than the replaced equipment or as directed by the Engineer. If the Contractor fails to perform required repairs or replacement work, as determined by the Engineer, the State may perform the repair or replacement work and the cost will be deducted from monies due to the Contractor.

A TMS element shall be considered nonoperational or off line for the duration of time that active communications with the TMC is disrupted, resulting in messages and commands not transmitted from or to the TMS element.

The Contractor shall provide provisions for replacing existing TMS elements within the project limits, including detection systems, that were not identified on the plans or during the pre-construction operational status check that became damaged due to the Contractor's activities.

If the pre-construction operational status check identified existing TMS elements, then the Contractor, the Engineer, and the Department's Traffic Operations Electrical representatives shall jointly conduct a post construction operational status check of all existing TMS elements and each element's communication status with the TMC. The Department's Traffic Operations Electrical representatives will certify the TMS elements' status and provide a copy of the certified list of the existing TMS elements within the project limits to the Contractor. The status list will include the operational, defined as having full functionality, and the nonoperational components. TMS elements that cease to be functional between pre and post construction status checks shall be repaired at the Contractor's expense and as directed by the Engineer.

The Engineer will approve, in writing, the schedule for final replacement, the replacement methods and the replacement elements, including element types and installation methods before repair or replacement work is performed. The final TMS elements shall be new and of equal or better quality than the existing TMS elements.

## **PAYMENT**

The contract lump sum price paid for maintaining existing traffic management system elements during construction shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in maintaining existing traffic management system elements as shown on the plans, specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

If no electrical work exists on the project and no TMS elements are identified within the project limits, the pre-construction operational status check will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

Furnishing and installing temporary or portable TMS elements that are not shown on the plans, but are required when an existing TMS element becomes nonoperational or off line due to construction activities, will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

Furnishing and installing temporary or portable TMS elements and replacing TMS elements that are not shown on the plans nor identified during the pre-construction operational status check and were damaged by construction activities will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

If the Contractor is required to submit provisions for the replacement of TMS elements that were not identified, the provisions will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications.

## **10-3.05 CAST-IN-DRILLED-HOLE CONCRETE PILE FOUNDATIONS**

### **GENERAL**

#### **Summary**

This work includes constructing cast-in-drilled-hole concrete pile foundations for sign and pole structures.

Comply with Section 86-2.03, "Foundations," of the Standard Specifications and "Piling" of these special provisions.

## **MATERIALS**

Concrete must contain not less than 590 pounds of cementitious material per cubic yard.

## **CONSTRUCTION**

For standards located in sidewalk areas, the pile foundation must be:

1. Placed to final sidewalk grade before the sidewalk is placed
2. Square for the top 4 inches

## **PAYMENT**

Payment for cast-in-drilled-hole concrete pile foundations shall conform to the provisions in "Piling" of these special provisions and Section 86-8, "Payment," of the Standard Specifications.

### **10-3.06 STANDARDS, STEEL PEDESTALS, AND POSTS**

Standards, steel pedestals, and posts for poles structures standards shall conform to the provisions in Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications, "Steel Structures" of these special provisions, and the following requirements.

Steel bolts not designated on the plans as high-strength (HS) or stainless steel shall be for general applications and shall conform to the requirements in ASTM Designation: A 307.

Anchor bolts shall conform to the requirements in ASTM Designation: F 1554, Grade 36. High-strength (HS) anchor bolts shall conform to the requirements in ASTM Designation: F 1554, Grade 105.

Handhole reinforcement rings for standards, steel pedestals, and posts shall be continuous around the handholes.

### **10-3.07 CONDUIT**

Conduit to be installed underground shall be Type 1 or Type 3 unless otherwise specified.

The conduit in a foundation and between a foundation and the nearest pull box shall be Type 1.

When Type 3 conduit is placed in a trench (not in pavement or under portland cement concrete sidewalk), after the bedding material is placed and the conduit is installed, the trench shall be backfilled to not less than 4 inches above the conduit with minor concrete conforming to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications, except the concrete shall contain not less than 590 pounds of cementitious material per cubic yard. The remaining trench shall be backfilled to finished grade with backfill material.

Conduit runs shown on the plans to be located behind curbs may be installed in the street, within 3 feet of, and parallel with the face of the curb, by the trenching in pavement method in conformance with the provisions in Section 86-2.05C, "Installation," of the Standard Specifications. Pull boxes shall be located behind the curb or at the locations shown on the plans.

After conductors have been installed, the ends of conduits terminating in pull boxes, service equipment enclosures, and controller cabinets shall be sealed with an approved type of sealing compound.

At those locations where conduit is required to be installed under pavement and underground facilities designated as high priority subsurface installation under Govt Code § 4216 et seq. exist, conduit shall be placed by the trenching in pavement method in conformance with the provisions in Section 86-2.05C, "Installation," of the Standard Specifications.

At other locations where conduit is required to be installed under pavement and if a delay to vehicles will not exceed 5 minutes, conduit may be installed by the "Trenching in Pavement Method."

Use the "T" trench detail as shown on the plans.

At the option of the Contractor, the final 2 feet of conduit entering a pull box in a reinforced concrete structure may be Type 4.

### **10-3.08 DIRECTIONAL BORING METHOD**

At the option of the Contractor, conduits shown to be installed at underground locations may be installed by the directional boring method. All pull boxes or vaults shall be located at the locations shown on the plans.

Minimum depth of conduit below finished grade in pavement areas shall be 30 inches.

A listing of materials (composition and strength) and methods used in directional boring shall be submitted for the Engineer's review.

The diameter of the boring tool shall not exceed 1.5 times the outside diameter of the conduit. Mineral slurry or wetting solution shall only be used to lubricate the boring tool and to stabilize the soil surrounding the boring path. Mineral slurry or wetting solution shall be water based and environmentally safe.

Residue from directional boring operations shall be handled in the same manner as specified for residue from slot cutting operations in Section 86-5.01A(4), "Installation Details," of the Standard Specifications.

The directional boring equipment shall have directional control of the boring tool and have an electronic boring tool location detection system. During operation, the directional boring equipment shall be able to determine the location of the tool both horizontally and vertically.

The directional boring equipment shall be equipped with a tension measuring device that indicates the amount of tension exerted on conduit during conduit pulling operations.

Slurry cement backfill and warning tape, as shown on the plans for trench installations of conduit, are not required where the directional boring method is used. Tracer wire shall be attached to the uppermost conduit prior to conduit installation.

Continuity of the tracer wire shall be verified after installation.

A representative of the Contractor must be in direct charge and control of the directional boring operation at all times.

The Engineer shall be notified in writing 2 working days in advance of starting directional boring operations. The location and equipment to be used in the boring operation shall be included in the advance notice to the Engineer. Directional boring shall only be performed in the presence of the Engineer unless otherwise notified in writing by the Engineer.

Full compensation for using directional boring method shall be considered as included in the contract lump sum prices paid for the various items of work involved and no additional compensation will be allowed therefor.

### **10-3.09 TRAFFIC PULL BOXES**

Grout shall not be placed in the bottom of traffic pull boxes.

### **10-3.10 PULL BOX**

#### **GENERAL**

##### **Summary**

This work includes installing a non-traffic-rated pull box as shown on the plans and as specified in these special provisions. Comply with Section 86-2.06, "Pull Boxes," of the Standard Specifications.

##### **Submittals**

Before shipping pull boxes to the jobsite, submit a list of materials, Contract number, pull box manufacturer, manufacturer's instructions for pull box installation, and your contact information to the Transportation Laboratory.

Submit reports for pull box from an NRTL-accredited lab to the Engineer.

##### **Quality Control and Assurance**

Pull boxes may be tested by the Department. Deliver pull boxes and covers to the Transportation Laboratory and allow 30 days for testing. When testing is complete, you will be notified. You must pick up the boxes and covers from the test site and deliver it to the job site.

Any failure of the pull box or the cover that renders the unit noncompliant with these specifications will be a cause for rejection. If the unit is rejected, you must allow 30 days for retesting. Retesting period starts when the replacement pull box is delivered to the test site. You must pay for all retesting costs. Delays resulting from submittal of noncompliant materials does not relieve you from executing the contract within the allotted time.

If the pull box submitted for testing does not comply with the specifications, remove the unit from the test site within 5 business days after notification that it is rejected. If the unit is not removed within that period, it may be shipped to you at your expense.

You must pay for all shipping, handling, and transportation costs related to the testing and retesting.

##### **Functional Testing**

The pull box and cover must be tested under ANSI/SCTE 77, "Specifications for Underground Enclosure Integrity."

##### **Warranty**

Provide a 2-year manufacturer replacement warranty for pull box and cover from the date of installation of the pull box and cover. All warranty documentation must be submitted to the Engineer before installation.

Replacement parts must be provided within 5 business days after receipt of failed pull box, cover, or both at no cost to the Department and must be delivered to the Department's Maintenance Electrical Shop at 30 Rickard Street, San Francisco, CA 94130.

## **MATERIALS**

The pull box and cover must comply with ANSI/SCTE 77, "Specifications for Underground Enclosure Integrity," for Tier 22 load rating and must be gray or brown in color.

Each pull box cover must have an electronic marker cast inside.

Extension for the pull box must be of the same material as the pull box and attached to the pull box to maintain the minimum combined depths as shown.

Include recesses for a hanger if a transformer or other device must be placed in a pull box.

The bolts, nuts, and washers must be a captive bolt design.

The captive bolt design must be capable of withstanding a torque range of 55 to 60 ft-lb and a minimum pull out strength of 750 lb. Perform the test with the cover in place and the bolts torqued. The pull box and cover must not be damaged while performing the test to the minimum pull out strength.

Stainless steel hardware must have an 18 percent chromium content and an 8 percent nickel content.

Galvanize ferrous metal parts under Section 75-1.05, "Galvanizing."

Manufacturer's instructions must provide guidance on:

1. Quantity and size of entries that can be made without degrading the strength of the pull box below Tier 22 load rating
2. Where side entries cannot be made
3. Acceptable method to be used to create the entry

Tier 22 load rating must be labeled or stenciled by the manufacturer on the inside and outside of the pull box and on the underside of the cover.

## **CONSTRUCTION**

Do not place grout in the bottom of the pull box.

Do not install pull box in curb ramps or driveways.

A pull box for a post or a pole standard must be located within 5 feet of the standard. Place a pull box adjacent to the back of the curb or edge of the shoulder. If this is impractical, place the pull box in a suitable, protected, and accessible location.

### **10-3.11 CONDUCTORS, CABLES, AND WIRING**

Splices shall be insulated by "Method B".

Conductors and cables shall be secured to the projecting end of conduit in pull boxes to prevent pulling.

Signal Interconnect Cable (SIC) shall be the 6-pair type.

## **TELEPHONE CABLE**

The telephone cable (TC) shall consist of 6 pairs of No. 19 solid copper conductors. Conductors shall be twisted in pairs. Each conductor shall be insulated with a high molecular weight, heat stabilized, color coded polyethylene material. The insulation shall be 18-mils nominal.

Color code for TC cable shall be as follows:

1. White/Blue
2. White/Orange
3. White/Green
4. White/Brown
5. White/Gray
6. Red/Blue

The core shall be protected by a non-hygroscopic polyester film with a single longitudinally applied 5-mils thick corrugated copper shield or 8-mils thick plastic coated aluminum shield. A moisture barrier of petrolatum-polyethylene compound shall be applied over the core tape and over and under the cable shield to fill all cable interstices.

The cable shall be provided with an outer jacket of extruded, black, high molecular weight, heat stabilized polyethylene material. The outer jacket shall have a thickness of 60-mils nominal. The outer diameter of the cable shall be 0.60-inch maximum.



All conductors shall be terminated inside the telephone demarcation cabinet and the controller cabinet as shown on the plans. All connections from the terminal block TB0 to the 8-position connecting block shall be via a cable consisting of 2 pairs of No. 22 solid conductors and shall meet the same specifications as the TC cable.

#### **10-3.12 SERVICE**

Service equipment enclosures shall be the aluminum type.

Circuit breakers shall be the cable-in/cable-out type, mounted on non-energized clips. All circuit breakers shall be mounted vertically with the up position of the handle being the "ON" position.

Each service shall be provided with up to 2 main circuit breakers which shall disconnect ungrounded service entrance conductors. Where the "Main" circuit breaker consists of 2 circuit breakers as shown on the plans or required in the special provisions, each of the circuit breakers shall have a minimum interrupting capacity of 10,000 A, rms.

#### **10-3.13 NUMBERING ELECTRICAL EQUIPMENT**

The placement of numbers on electrical equipment will be done by others.

#### **10-3.14 MODEL 334T CONTROLLER CABINETS**

Each cabinet shall conform to Chapter 6 of the Transportation Electrical Equipment Specifications (TEES) and shall consist of a Housing 1B, a Cabinet cage 1, and the following listed equipment:

1. Service panel Assembly 1
2. Power distribution assembly (PDA) 3L
3. Three equipment shelves with brackets as specified in "Camera Station" of these special provisions
4. Dual fan assembly with thermostatic control

Prior to shipping to the project site, each Model 334T controller cabinet shall be submitted to the Transportation Laboratory for acceptance testing.

The Engineer shall be notified when each Model 334T controller cabinet is ready for the functional test. The functional test will be conducted by State forces.

Three equipment shelves shall be furnished as shown on the plans.

The toggle power switches, conforming to the provisions in Section 6.2.6.3 of the TEES, will not be required. One No. 18 AWG minimum jumper shall be provided on the rear of power distribution assembly No. 3L to bypass the "Police Lights" switch.

One push button power switch shall be installed in the upper inside corner of the housing for each door. Each switch shall be open when its corresponding door is open. Each switch shall be furnished with 2 conductors, each a minimum of 3 feet, coiled for future termination.

#### **10-3.15 DETECTORS**

Loop wire shall be Type 2.

Loop detector lead-in cable shall be Type B.

Slots shall be filled with elastomeric sealant or hot-melt rubberized asphalt sealant.

The depth of loop sealant above the top of the uppermost loop wire in the sawed slots shall be 2 inches, minimum.

Slots in portland cement concrete shall be filled with elastomeric sealant or hot-melt rubberized asphalt sealant, or shall be filled with an epoxy sealant conforming to the provisions in Section 95-2.09, "Epoxy Sealant for Inductive Loops," of the Standard Specifications.

#### **10-3.16 INFORMATIONAL MESSAGE SIGN ASSEMBLY**

##### **GENERAL**

##### **Summary**

This work includes installing an Informational Message Sign (IMS) assembly as shown on the plans and as specified in these special provisions.

IMS assembly shall consist of:

1. Sign panel
2. Sign controller assembly
3. NEMA 4 enclosure

#### 4. IMS interface cable

IMS assembly shall operate at a frequency of 60  $\pm$ 3 Hz AC line over a voltage from 90 to 135 V(ac). AC voltage fluctuations shall cause no visible flicker or change in pixel luminous intensity. The rated voltage for measurements shall be 120 V(ac).

IMS assembly shall include voltage surge protection to withstand high repetition noise transient as specified in section 2.1.6.1 of NEMA Standard TS-2.

IMS assembly shall not conduct or radiate signals adversely affecting other electrical or electronic equipment, including other control systems, data processing, audio, radio and industrial equipment, as specified in Subpart B, "Unintentional Radiators," of Part 15, "Radio Frequency Devices," in Federal Communications Commission Title 47.

The IMS assembly shall meet vibration requirements specified in NEMA Standard TS-1 and TS-4.

All wiring shall be No. 22 AWG or larger, and shall be color-coded per TEES Section 1.13.3.6. All wiring shall be bundled, wrapped, and permanently labeled.

#### **Submittals**

At least 30 days before fabrication of IMS assembly, the Contractor shall submit to the Engineer for review:

1. Three sets of shop drawings showing the mechanical and electrical systems and circuits.
2. Two copies of the manual as specified in these special provisions.

The Contractor shall allow 14 days for the Engineer's review.

If any changes to the approved shop drawings were made during IMS assembly, the Contractor shall submit to the Engineer three updated sets of shop drawings at least 30 days prior to IMS assembly installation.

Before IMS assembly is shipped to the site, the Contractor shall submit to the Engineer:

1. Two copies of the manuals for each IMS, total number of copies not to exceed 30
2. Documentation for quality assurance inspection, functional testing and acceptance testing performed by the manufacturer

All pages in the manual shall be securely fastened together between protective covers. Loose-leaf ring binding shall be acceptable.

The manual shall include the following sections and sub-sections:

1. General:
  - 1.1. Description of the equipment design features, including any modification of the standard equipment if applicable, performance, and applications
  - 1.2. Equipment specifications summary
  - 1.3. List of assemblies, subassemblies and parts for each specified equipment component
  - 1.4. Equipment installation instructions
2. Theory of Operations of:
  - 2.1. Standard equipment, with unique or unusual circuitry described in detail
  - 2.2. Any modification to the standard equipment
3. Service and Maintenance:
  - 3.1. Recommended test equipment and fixtures, or minimum operational and performance requirements for test equipment
  - 3.2. Troubleshooting information and charts
  - 3.3. Removal and installation procedures for replacing assemblies and subassemblies, if not obvious or if improper procedure may result in damage
4. Replacement Parts:
  - 4.1. Lists of electrical parts, mechanical parts and assemblies, with each semiconductor device identified by the supplier's number and by industry standard part numbers.

5. Diagrams:

- 5.1. Schematic diagrams identifying all circuit components and showing normal test voltages and levels
- 5.2. Overall functional block diagram
- 5.3. Detailed interconnecting diagrams showing wiring between modules, circuit boards and major components
- 5.4. Pictorial circuit board layout diagrams showing component placement and printed wiring detail
- 5.5. Diagrams showing location of circuit boards and other subassemblies
- 5.6. Exploded view diagrams of complex mechanical assemblies

**Warranty**

Before IMS assembly installation, the Contractor shall submit to the Engineer a written manufacturer's warranty against defects in materials and workmanship.

The manufacturer shall replace or repair any sign panel or sign controller that failed due to workmanship or material defects within 48 months of the successful completion of IMS assembly testing.

Replacement shall be provided at no cost to the State within 15 days after receipt of failed parts. Replacement parts shall be delivered to State Maintenance Electrical Shop at Caltrans Maintenance Station, 30 Rickard Street, San Francisco, CA 94134.

**MATERIALS**

**Sign Panel**

**General**

The sign panel shall consist of:

1. Front face
2. Housing
3. Internal power supply to operate the sign

Sign panel dimensions shall not exceed 48" (W) x 32" (H) x 8" (D). Sign panel weight shall not exceed 120 pounds.

The sign panel power factor shall be greater than 90 percent, and current total harmonic distortion shall be less than 25 percent. The maximum power consumption of sign panel shall be 150 W.

Sign panel shall have dimming capability as specified in these special provisions.

The sign panel shall be made rain-tight with a closed-cell neoprene gasket between front face and housing.

**Front Face**

The front face shall consist of a pixel module and an outer frame.

The front face shall be:

1. Hinged to allow access to the interior of the sign panel housing
2. Equipped with a locking device to remain in open position

**Pixel Module**

Pixel module shall have a full matrix of pixels, with a minimum of 30 pixels wide by 18 pixels high. The pixels shall have a minimum horizontal and vertical pitch of 1.25 inch.

Pixel module shall include a lens panel clear glazing made of polycarbonate resin thermoplastic. The polycarbonate resin thermoplastic shall meet the following minimum requirements:

1. Minimum thickness: 0.125 inch
2. Color: clear
3. Tensile Strength, Ultimate: 9,500 psi
4. Tensile Strain at Yield: 6 percent
5. Tensile Modulus: 300,000 psi
6. Flexural Modulus: 300,000 psi
7. Impact Strength, Izod (up to 125 mils, notched): 12-16 ft-lb/in
8. Rockwell Hardness: M70, R118

9. Heat Deflection Temperature Under Load: 270 °F (264 psi); 288 °F (66 psi)
10. Coefficient of Thermal Expansion:  $3.75 \times 10^{-5}$  in/in/ °F
11. Initial Light Transmittance: 88 percent (average)
12. Change in Light Transmittance, 5 years exposure: less than 5 percent
13. Change in Yellowness Index, 5 years exposure: less than 5 percent

The following pixel module information shall be permanently marked on the back of the panel:

1. Manufacturer's name and trademark
2. Model number
3. Serial number
4. Rated voltage, current, power consumption and Volt-Amperes (VA) per pixel

Each pixel shall consist of multiple high-intensity ultra-bright Aluminum Indium Gallium Phosphide (AlInGaP) T 1-3/4 light-emitting diodes (LED).

Failure of one LED shall not result in the loss of more than 40 percent of the total number of LEDs for that pixel.

The power consumption of each pixel, including its driving circuitry, shall not exceed 1.5 W.

Each pixel shall have a maximum LED array size:

1. 0.75 inch diameter for circular array
2. 0.75 inch square for square array

The LEDs shall be evenly distributed throughout the pixel.

Each pixel shall have:

1. Viewing angle: 30 degrees
2. Initial nominal luminous intensity on the maximum setting: 9.5 cd
3. Minimum useful life rating: 48 months
4. Minimum intensity at temperatures from -34 to +165 °F: 85 percent

The measured chromatic coordinates of each pixel shall conform to the chromaticity requirements in section 5.3.2.1 and Figure C of the Equipment and Materials Standards in the Institute of Transportation Engineers ITE Publication ST-017A.

Each LED shall be:

1. Rated for 100,000 hours of continuous operation at temperatures from -34 to + 165 °F
2. Emitting yellow color light with wavelength  $592 \pm 5$  nm
3. UV-stabilized
4. From the same manufacturer and color bin

Each LED shall be individually mounted directly to a printed circuit board (PCB) and shall be easily replaceable and individually removable using conventional electronics repair methods. Each LED shall have a standoff holding the base of the LED  $0.15 \pm 0.05$  inch above PCB surface.

Each pixel shall have a device attached to the PCB and holding LEDs at  $90 \pm 0.5$  degrees to PCB surface.

Each device shall:

1. Be black in color
2. Protect the LED from damage during assembly, testing, removal, normal operation, and repair
3. Not block airflow to the LED
4. Not obstruct the light output of the LED at specified viewing angle

### **Outer Frame**

The outer frame shall be an aluminum sheet, 0.090-inch minimum thick, with one circular aperture for each pixel in the pixel module. The aperture diameter shall be the smallest one that does not obstruct LED light output at specified viewing angle.

The exterior surface of outer frame shall be coated with a factory-applied, oven-baked finish based on polyvinylidene fluoride resin. The finish shall be:

1. Matte-black in color
2. Applied by an applicator approved by the formulator
3. Meeting the performance criteria of AAMA 2605 specification

The lens panel clear glazing shall be laminated and sealed to the interior surface.

### **Housing**

The housing shall consist of:

1. Aluminum frame made of extruded aluminum alloy 6061-T6
2. Rear, sides, top and bottom made of sheet aluminum alloy 5052-H32, 0.125 inch minimum thick, with a natural aluminum mill finish on interior and exterior surfaces
3. External and internal hardware made of either stainless steel or cadmium-plated steel

The housing frame shall have fully welded seams. The aluminum sheets shall be stitch-welded to the housing frame.

Panel manufacturer's name and trademark shall be permanently marked on the side of the housing. Panel model, serial number and shipping date shall be stamped on a tag that shall be affixed to the side of the housing. The lettering shall have a minimum height of 0.3125 inch. The lettering on a tag may be either depressed or raised, and shall be legible and durable.

### **Sign Controller Assembly**

#### **General**

Sign controller assembly shall consist of:

1. Sign controller
2. Dim test switch
3. Controller reset switch
4. Local communications cable
5. Two NEMA 5-15R GFCI receptacles
6. Field wiring isolation / termination board mounted inside the enclosure
7. Power supply
8. Sign operating software

#### **Sign Controller**

Sign controller shall have power-up and auto-restart capabilities with a programmable default message, including a blank message, when recovering from a power off condition. A hardware watch dog circuit shall be used to provide automatic reset to the sign controller.

Sign controller shall include:

1. Communication interface for remote communications
2. Firmware
3. Dimming control

#### **Communications Interface**

Communication interface shall include:

1. Two configuration ports supporting TIA-232 through DE9 connector.
2. Network communications port supporting Ethernet 10/100 Mbps through 8P8C modular connector.

Sign controller shall be controlled via:

1. Local TIA-232 port
2. Either Ethernet or remote TIA-232 port

Commands communicated via the local TIA-232 port shall have higher priority.

## **Firmware**

Firmware shall allow creating, editing and saving a minimum of 50 messages and 99 pages. These shall be stored in non-volatile memory and shall remain unaltered for a minimum of 30 days without AC power to the sign controller.

The firmware shall be NTCIP (National Transportation Communication for ITS Protocol) compliant including, the following standards:

1. NTCIP 1203, v02.39b "Object Definitions for Dynamic Message Signs" including normative references.
2. NTCIP 1101 "Simple Transportation Management Framework".
3. NTCIP 2103 "Point to Point Protocol over TIA-232 Subnetwork Profile".
4. NTCIP 2201 "Transportation Transport Profile".

The firmware shall support the following Tags as defined in NTCIP 1203, v02.39b:

1. Flash
2. Font
3. Graphic
4. Justification – Line
5. Justification – Page
6. New Line
7. New Page
8. Page Time
9. Spacing Character

The firmware shall support the following diagnostic tests:

1. Pixel Test:
  - 1.1 Operational status of each pixel shall be recorded by pixel row (top to bottom) and pixel column (left to right) as one of the following:
    - 1.1.1. working
    - 1.1.2. partial out
    - 1.1.3. full out
    - 1.1.4. partial stuck on
    - 1.1.5. full stuck on
  - 1.2. A list of pixels with operational status other than "working" shall be transmitted via any communication port upon request. The test shall be completed in less than 0.5 seconds, regardless of current IMS message status. The test shall be run automatically every 24 hours or upon request.
2. Pixel Read:
  - 2.1. Operational state of each pixel, either "on " or "off", shall be recorded by pixel row (top to bottom) and pixel column (left to right) during message downloads and during every sign poll. A separate recording shall be made for each page of a multi-page message, or during the blank portion of a flashing message.
  - 2.2. This test shall be performed while a message is displayed on the sign. The test shall not affect displayed message. Each performance of this test shall be independent of previous test results. The results of this test shall be transmitted upon request.

### **Dimming Control**

The sign controller shall automatically adjust the intensity of all pixels by using input from a minimum of 2 photo sensors measuring ambient light and installed in the sign housing. There shall be a minimum of three adjustable levels of luminance: 100 percent, 60 percent, and 30 percent luminance.

### **Dim Test Switch**

A single-throw "Dim Test" switch shall override the automatic intensity selection and force each activated pixel to 30 percent luminance.

### **Controller Reset Switch**

A single-throw momentary "Controller Reset" switch shall generate an automatic reset to the sign controller.

### **Local Communications Cable**

A cable shall be provided to allow for the connection of a laptop to the local TIA-232 port. The cable shall be a minimum of 6 feet in length. The cable shall consist of 3 conductors (TxD, RxD and Ground) and shall be terminated in a 9-pin D-shell socket connector per TIA-574.

### **Field Wiring Isolation / Termination Board**

All communication and control signals between the sign controller and the sign panel shall be terminated on the field wiring isolation / termination board and shall be opto-coupled.

### **Power Supply**

One industrial-grade switching DC power supply unit shall be provided. The power supply voltage shall not exceed 24 V(dc) under normal load. The power supply shall have an efficiency of 75 percent.

### **Sign Operating Software**

One copy of the Sign Operating Software (SOS) for IMS testing via the local TIA-232 port shall be provided for each IMS assembly, not to exceed maximum number of 10 copies. Each copy shall be on a CD-ROM and shall be Windows XP compatible.

## **NEMA 4 Enclosure**

### **General**

NEMA 4 enclosure dimensions shall not exceed 28" (W) x 16" (H) x 12" (D). Enclosure weight shall not exceed 25 pounds.

### **Enclosure Construction**

The enclosure shall be fabricated from galvanized sheet steel, or shall be fabricated from sheet steel and zinc- or cadmium-plated after fabrication, or shall be fabricated from aluminum.

The enclosure shall be furnished with a rear mounting board made of 0.5-inch thick, grade ACX, plywood or 0.08-inch thick aluminum.

Mounting board shall be centered on the enclosure wall and shall have 0.5 inch clearance to the adjacent walls.

Each listed component of the sign controller assembly shall be mounted on the rear mounting board.

The enclosure shall have one door, which shall be side-hung with a continuous stainless steel piano hinge. The hinge shall be mounted so that it is not accessible from the outside when the enclosure door is closed.

The door and hinges shall be able to withstand a vertical load of 100 pounds per foot of door height applied to the outer edge of the open door without permanent deformation of the door or cabinet body.

The door opening shall be double flanged on all four sides.

Dust and weather resistant seal at the enclosure door shall be created by installing closed-cell neoprene gasket.

The enclosure shall be equipped with a draw latch welded to the enclosure and the door. The latch shall have a padlock hole with a minimum diameter of 0.4375 inch.

Manufacturer's name and trademark shall be permanently marked inside the enclosure. Model, serial number and shipping date shall be stamped on a tag that shall be affixed inside the cabinet. The lettering shall have a minimum height of 0.3125 inch. The lettering may be either depressed or raised, and shall be legible and durable.

### **IMS Interface Cable**

The IMS interface cable (IIC) shall connect the sign panel to sign controller assembly and shall be continuous without splicing, with 50 feet minimum length. The IIC shall be approved for use by the sign manufacturer. The manufacturer's identification shall be printed in white ink every foot along the surface of the IIC. The IIC shall be certified for outdoor use.

## **CONSTRUCTION**

### **Installation**

The IMS assembly shall be installed as shown on the plans and as directed by the Engineer. The Contractor shall configure the sign controller assembly to make IMS assembly operational and ready to accept communications. The Contractor shall provide to the Engineer documentation detailing the configuration of each IMS assembly.

### **Testing**

After installation at the site, a minimum of 5 different messages composed of text and graphics shall be displayed. Any others tests recommended by the manufacturer shall also be conducted. Each IMS assembly shall conform to requirements specified in "System Testing and Documentation" in these special provisions.

### **10-3.17 CAMERA STATION**

This work includes furnishing, testing, and installing closed circuit television (CCTV) equipment at each pan/tilt/zoom (PTZ) camera station and fixed camera station, furnishing service manuals, and testing existing CCTV equipment, as shown on the plans and as specified in these special provisions.

The Contractor shall install the following CCTV equipment at each PTZ camera station and fixed camera station:

1. CCTV (PTZ) Camera Station:

- 1.1. One CCTV foundation, pole and camera mounting adapter
- 1.2. One CCTV (PTZ) camera unit
- 1.3. Hybrid camera cable (HCC), connectors and fittings as required
- 1.4. Interface cable and conductors as required
- 1.5. One camera control unit (CCU)
- 1.6. One video encoder unit (VEU)
- 1.7. Equipment shelf with brackets as required
- 1.8. Rack-mount power strip

2. CCTV (Fixed) Camera Station:

- 2.1. One or more CCTV (fixed) camera unit
- 2.2. HCC, connectors and fittings as required
- 2.3. Interface cable and conductors as required
- 2.4. Multiple camera termination unit (MCTU)
- 2.5. One or more VEU
- 2.6. Equipment shelf with brackets as required
- 2.7. Rack-mount power strip

3. The Contractor shall furnish all materials necessary to provide a complete and functional PTZ camera station and fixed camera station in accordance with these special provisions. Miscellaneous equipment, and materials not mentioned but necessary to provide a complete and fully operational PTZ camera station and fixed camera station shall be furnished by the Contractor as incidental to the work for which no additional compensation will be allowed therefor.

4. All items furnished under this contract shall be new and shall be the latest version.

## **INSTALLATION**

### **Installation of CCTV (PTZ) Camera Station**

The Contractor shall install CCTV pole with foundation, conduits and pull boxes as required and as shown on the plans. The type of CCTV pole is shown on the plan and shall meet the specifications describe elsewhere in these special provisions. The Contractor shall install and terminate the HCC with connectors as shown on the plans. The



HCC shall connect to camera pigtail cable and secure to the pole as shown on the plans for strain-relief.

The CCTV (PTZ) camera unit shall be installed on camera mounting plate as shown on the plans. The CCTV (PTZ) camera unit shall be secured to the mounting plate using the stainless steel bolts provided with the CCTV (PTZ) camera unit. Before each bolt is fastened, a locking type coating shall be applied to the threads. The coating shall lock the bolt and nut in place, making it impossible to turn the bolt or nut without tools. This coating shall last through and be effective through at least ten insertions and withdrawals of the bolt or nut.

The Contractor shall install CCU, VEU, router, rack-mount power strip, equipment shelves and all the interface cables in the controller cabinet as shown on the plans. The rack-mount power strip shall be mounted on the rear mounting rack of the controller cabinet.

#### **Installation of CCTV Fixed Camera Station**

The Contractor shall install fixed camera with mounting hardware as shown on the plans. The Contractor shall install and terminate the HCC with connectors as shown on the plans.

The Contractor shall install VEU, router, rack-mount power strip, equipment shelves and all the interface cables in the controller cabinet as shown on the plans. The rack-mount power strip shall be mounted on the rear mounting rack of the controller cabinet.

#### **TESTING CCTV CAMERA STATION**

Upon completion of work, each CCTV (PTZ) and fixed camera station shall be subjected to post-installation tests as outlined herein. All software shall be provided and loaded before the start of testing. The District Electrical Systems Branch personnel, arranged by the Engineer and in the presence of the Contractor, shall perform all tests. The Contractor shall notify the Engineer in writing fifteen days prior to the scheduled testing. Upon receipt of the notification, the Engineer will contact Office of Electrical Systems at (510) 286-6142. The Contractor shall provide all necessary equipment required to access the CCTV equipment for testing.

In each CCTV (PTZ) and Fixed Camera Station, the camera unit shall be assembled, inspected and tested in accordance with these special provisions prior to delivery to the job site. Installation, operations and maintenance manuals shall also be submitted at the time of delivery. The Contractor shall submit the applicable documents of the U.S. Military Specification (MIL-SPEC), Underwriters Laboratories Inc. (UL), Electronics Industries Association (EIA) Standards and other Standards from parts of the specification to the extent specified in these standards. In the event of a conflict between the content of this section and the content of the specification, the standards defined in this section shall supersede.

| Military Specification Documents |  |
|----------------------------------|--|
| AMSI/NCSL Z540-1                 | Calibration System Requirements  |
| MIL-STD-461A                     | Electromagnetic Interface Characteristics Requirements for Equipment, Subsystems & Systems |
| MIL-E-5400T                      | Electronic Equipment, Airborne General Specification                                       |
| MIL-STD-810E                     | Environmental Test Methods   |
| MIL-C-5541E                      | Chemical Conversion Coatings on Aluminum Alloys  |

| Underwriters' Laboratory, Inc. and other documents |  |
|--|--|
| UL-796   | Printed Circuit Boards   |
| EIA-330  | Electrical Performance Standards for CCTV Camera 525/60 Interlaced |

#### **Camera**

Each camera shall meet the following specifications at a minimum:

|                          |  |
|--------------------------|--|
| Imager                   | Interline transfer Progressive Scan CCD with mosaic-type color compensating filter |
| Image Area               | 1/4" Format, 0.14" (H) x 0.11" (V)   |
| Resolution               | 540 horizontal; 350 vertical   |
| Minimum Picture Elements | 811 (H) x 508 (V), Total 411,988   |
| Video Output             | NTSC, 1 V p-p at 75 ohms, unbalanced   |
| Lens                     | Aperture: f/1.4 (wide angle) to f/4.2 (telephoto)                                  |
| Optical Zoom Range       | 35X, 0.13" to 4.68"  |
| Digital Zoom Range       | 1X (Off) through 210X, Smooth transition from Optical to Digital Zoom              |

|                            |  |
|----------------------------|--|
| Horizontal Angle of View   | Optical: From 55.8 to 1.7 degrees; At 10X Digital: From 55.8 to 0.17 degrees.  |
| Focus Distance.            | 40" in telephoto, 0.4" in wide angle   |
| Digital Compass            | 8 or 16 direction point compass annotation with primary direction spelled out and intermediate directions abbreviated with two letters   |
| Auto Focus                 | Selectable Auto/Manual   |
| Manual Focus Speed         | Approximately 2.0 seconds to full range  |
| Minimum Scene Illumination | For Reliable Auto Focus, 30 percent video  |
| Zoom and Focus Presets     | 64 preset positions with auto focus and ID   |
| Flash Memory               | Update firmware and new features via serial communication  |
| Shutter speeds             | 1/60; 1/120; 1/180; 1/250; 1/500; 1/1,000; 1/2,000; 1/4,000; 1/10,000; 1/30,000 second   |
| Auto Iris                  | Automatically adjusts to compensate for changes in scene illumination to maintain constant video level output within sensitivity specifications  |
| Manual Iris                | Changing the video level to give the effect of open iris/close iris  |
| Gamma                      | 0.45   |
| AGC                        | From 0 to 28 dB  |
| Color Balance              | Auto Tracking Color Balance/Manual with adjustable Red and Blue Levels   |
| Signal to Noise Ratio      | >50 dB   |
| Synchronization            | Crystal or Phase-Adjust Line Lock on 60 Hz   |
| Sensitivity                | At F1.4, Wide Angle 35 IRE<br>0.5-Lux at 1/60 s, F1.4, Shutter, Color I.R. Cut On<br>0.05-Lux at 1/2 s, F1.4, Shutter, Color I.R. Cut On<br>0.2-Lux at 1/60 s, F1.4, Shutter, monochrome mode I.R. Cut Off<br>0.01-Lux at 1/4 s, F1.4, Shutter, monochrome mode I.R. Cut Off |

Pan and tilt function specifications:

|   |   |
|---|---|
| 1 | Continuous rotation capability in either direction                          |
| 2 | 110 degrees of tilt movement, +20 degree to -90 degree unobstructed         |
| 3 | Pan Speed (Operator Control): Variable from 0.1 degree/s to 80 degree/s     |
| 4 | Pan Speed (Preset Control): >140 degree/s                                   |
| 5 | Tilt Speed (Operator Control): Variable from 0.1 degree/s to 40 degree/s    |
| 6 | Tilt Speed (Preset Control): 140 degree/s                                   |
| 7 | 64 Pan and Tilt preset positions with repeatability within $\pm 0.5$ degree |
| 8 | The positioning system shall be invertible if inverse mounting is required  |

The testing shall consist of five consecutive days of continuous satisfactory operation of each camera station. If any material and equipment furnished and installed by the Contractor in this project is found defective or otherwise unsuitable, or the workmanship does not conform to the accepted standards, the Contractor shall replace such defective material and equipment at no cost to the State.

The Contractor may offer rejected material or equipment for consideration provided all non-compliance has been corrected and pretested by the Contractor. After all defects have been corrected, the camera station shall be re-tested until five consecutive days of continuous satisfactory operation is obtained.

The post-installation tests shall consist of, but not be limited to, inspection and functional testing in accordance with these special provisions.

Inspection shall consist of, but not be limited to, verification of correct wiring terminations, correct cable interconnections, good workmanship and compliance with these special provisions.

#### **Functional Testing for CCTV (PTZ) Camera Station**

The tests shall include, but not be limited to, the following:

1. Verify all local mode CCTV operations using the CCU front panel controls.
2. Verify video signal output from CCU with a National Television Systems Committee (NTSC) monitor.
3. Verify the correct operation of the auto/manual iris and focus, and manual zoom functions.

4. Verify the correct operation of the pan/tilt function. The pan/tilt function shall be tested over 355 degrees in the horizontal plane and +20 to -90 degrees in the vertical plane
5. Verify the correct operation of the preset positions.

#### **Functional Testing for CCTV Fixed Camera Station**

The tests shall include, but not be limited to, the following:

1. Verify video signal output from fixed camera with a National Television Systems Committee (NTSC) monitor.
2. Verify the correct operation of the auto/manual iris and focus, and manual zoom functions with a laptop PC software.
3. Verify the correct operation of the preset positions.

### **CAMERA UNIT**

#### **CCTV (PTZ) Camera Unit**

Each CCTV (PTZ) camera unit shall consist of a camera, lens, receiver/driver, pan/tilt assembly, environmental housing, sunshield and pigtail cable with connector. The CCTV (PTZ) camera unit shall automatically switch to monochrome mode when ambient light level is at 20 foot-candles and switch back to color at 180 foot-candles.

The CCTV (PTZ) camera unit shall have eight programmable camera movement sequences. Each sequence is programmed by selecting the preset position by number, and then selecting a dwell time. The presets can be used in any order, and the same preset may be used more than once as long as the total number of preset positions used does not exceed 32. The dwell time defines the length of time paused at each preset position. It can be from 1 second to 60 seconds. The dwell time can be changed individually for all stops on the sequence. If the appropriate preset ID is programmed, it shall be displayed for each preset position used on the sequence. The sequence shall stop upon receipt of a pan command. All programmable functions shall be stored in non-volatile memory.

Preset ID shall be 1 line, up to 24 characters long, user programmable for each of the 64 preset positions. When a preset position is recalled the corresponding preset ID shall be displayed. The preset ID shall remain displayed until a pan, tilt, zoom, manual focus, auto focus select, or another preset command is received.

#### **Camera Pigtail Cable and Connector**

The camera pigtail cable shall conform to the specifications for "Hybrid Camera Cable" in these special provisions. The length of the camera pigtail cable shall not be less than 32". The terminating connector shall be equivalent to an Amphenol 206036-3 with back shell 206070-1.

The contact pin assignment of the connector shall be:

| Position | Function      | Position | Function            |
|----------|---------------|----------|---------------------|
| 1        | Video, 75 ohm | 9        | Not Used            |
| 2        | Video Ground  | 10       | Not Used            |
| 3        | Data Ground   | 11       | Not Used            |
| 4        | Tx-           | 12       | 115 V(ac) Line, Hot |
| 5        | Tx+           | 13       | 115 V(ac), Neutral  |
| 6        | Rx+           | 14       | Not Used            |
| 7        | Rx-           | 15       | 115 V(ac), Ground   |
| 8        | Not Used      | 16       | Not Used            |

The Contractor shall furnish a mating connector, Amphenol 206037-1 with back shell 206070-1 and sixteen contact crimping sockets for each CCTV (PTZ) camera unit supplied in the contract.

#### **Physical and Mechanical Requirements for PTZ Camera Unit**

Each CCTV (PTZ) camera unit shall weigh less than 20 pounds. Its dimensions shall be less than 14" in length, 7" in width and 12" in height, including mounting base. The CCTV (PTZ) camera unit shall be a pole mount version. There shall be four equal spaced mounting holes on the mounting base. Each CCTV (PTZ) camera unit shall be provided with four stainless steel hex head bolts to secure the CCTV (PTZ) camera unit to the camera mounting plate. All fasteners and nuts used in attaching the CCTV (PTZ) camera unit to the mounting plate shall be of grade 18-8 stainless steel. A camera-mounting adapter shall be provided as shown on the plans.

### **CCTV Fixed Camera Unit**

Each CCTV fixed camera unit shall consist of a camera, lens, receiver/driver, environmental housing, sun shield and a cable connector. The CCTV fixed camera unit shall automatically switch to monochrome mode when ambient light level is at 20 foot-candles and switch back to color at 180 foot-candles.

The CCTV fixed camera unit shall have eight programmable camera sequences. Each sequence is programmed by selecting the preset position by number, and then selecting a dwell time. The presets can be used in any order, and the same preset may be used more than once as long as the total number of preset positions used does not exceed 32. The dwell time defines the length of time paused at each preset position. It can be from 1 second to 60 seconds. The dwell time can be changed individually for all stops on the sequence. If the appropriate preset ID is programmed, it shall be displayed for each preset used on the sequence. The sequence shall stop upon receipt of a control command. All programmable functions shall be stored in non-volatile memory.

Preset ID shall be 1 line, up to 24 characters long, user programmable for each of the 64 presets. When a preset is recalled the corresponding preset ID shall be displayed. The preset ID shall remain displayed until a zoom, manual focus, auto focus select, or another preset command is received.

### **Camera Connector**

Camera connector shall be mounted on the backplate of the camera housing. The camera connector shall be equivalent to an Amphenol PT07-14-18P.

The contact pin assignment of the connector shall be:

| Position | Function           | Position | Function            |
|----------|--------------------|----------|---------------------|
| S        | Video, 75 $\Omega$ | J        | Not Used            |
| H        | Video Ground       | K        | Not Used            |
| G        | Data Ground        | R        | Not Used            |
| F        | Tx-                | T        | Not Used            |
| E        | Tx+                | L        | Not Used            |
| M        | Rx+                | D        | 115 V(ac) Line, Hot |
| N        | Rx-                | C        | 115 V(ac), Neutral  |
| A        | Not Used           | P        | 115 V(ac), Ground   |
| B        | Not Used           | U        | Overall Shield      |

The Contractor shall furnish a mating connector, AMP PT06A-14-18S (SR) with 90 degree back shell.

### **Physical and Mechanical Requirements for Fixed Camera Unit**

Each CCTV fixed camera unit shall weigh less 10 pounds. Each camera and lens shall be mounted in a sealed, cylindrical, environmental housing which shall be less than 5 inches in diameter and 15 inches in length. The CCTV fixed camera unit shall have three equally spaced mounting holes on the mounting base. Each CCTV fixed camera unit shall be provided with three stainless steel hex head bolts to secure the CCTV fixed camera unit to the camera mounting plate. All fasteners and nuts used in attaching the CCTV fixed camera unit to the mounting plate shall be of grade 18-8 stainless steel. A camera-mounting bracket shall be provided as shown on the plans.

### **Camera Unit Features Common For PTZ And Fixed Camera Unit**

The camera housing shall be a corrosion resistant and tamper proof sealed and pressurized housing with five pounds dry nitrogen with Schrader purge fitting and 20 psi relief valve for each camera. The size of the housing shall be 3-1/2" diameter or smaller. The housing exterior shall be finished by pre-treatment with conversion coating and baked enamel paint. The camera enclosure shall be designed to withstand the effects of sand, dust and hose-directed water.

The internal humidity of the housing shall be less than 10 percent, when sealed and pressurized. Desiccant packs shall be securely placed inside the housing to absorb any residual moisture and maintain internal humidity at 10 percent or less. The housing shall include a thermostatically controlled heating pad rated at 115 V(ac) 100 W maximum.

A sun shield or visor shall be provided to shield the lens from direct sunlight.

The camera unit shall include a character generator. The text characters shall be uppercase white with black border impose on the video stream. A maximum of six lines of user programmable alphanumeric text shall be displayed through serial communications. Messages can be positioned at either the top or the bottom of display. The right side positioning is accomplished by padding left side of message with spaces. Blank lines shall not be

displayed. Any programmed line being displayed shall fill in toward the top if top positioning is selected, or toward the bottom if bottom position is selected.

Camera ID shall be used for upper 2 lines with each up to 24 characters long. If both lines are programmed, line 1 of camera ID shall always appear above line 2 of camera ID regardless of top or bottom selection.

An 8-point or 16-point compass annotation shall be settable for a true north position. Display shall include North, NE, East, SE, South, SW, West and NW. Position shall be able to be grouped with the site location or separated from site location. Azimuth and elevation position shall be displayed in 0 to 359 degrees and +95 to -95 degrees, respectively. All display shall be user selectable for enable/disable, 3-second time out or permanent display. Sector message of up to 16 sectors in 360 degrees shall be defined with up to 24 characters long.

Low-pressure indicator shall use 1 line with messages displayed in "blinking" or "non-blinking" mode when activated by low internal pressure. Adjustable set points by altitude shall be provided via the serial port to activate low-pressure. Message shall be enabled or disabled. In maintenance mode readings of the internal pressure of the camera housing shall be displayed from 5 psi down to 1 psi, in 0.1-psi increments.

Internal temperature indicator shall use 1 line with messages displayed in "blinking" or "non-blinking" mode. Message shall be enabled or disabled. In maintenance mode, camera readings of the internal temperature of the camera housing shall be in 1-degree increments.

Video blanked for up to 8 privacy zones shall be provided. One line numeric messages shall be displayed. Message shall be displayed in "blinking" or "non-blinking" mode and be enabled or disabled. Privacy zones shall be programmed through serial communications.

Control and addressing the camera unit shall be done through TIA-422 optically isolated serial communications. Additional protocols shall consist of Cohu, American Dynamics, Javelin, Philips/Bosch, Vicon and Pelco-D. The National Transportation Communications for ITS Protocol (NTCIP) 1205 protocol communications protocol shall be included as an option. Refer to NTCIP 1205 protocol for detailed description.

Upon receipt of any given command, the camera unit shall response in less than 1.0 second.

All programmable functions including camera last operating position shall be stored in non-volatile memory and shall not be lost if a power failure occurs. Upon power restoration, the camera shall go through a series of self-testing/calibration and return to the same position it left before the power interruption. System configurations such as video privacy zones, preset text and sector ID shall be able to be stored in a computer file and a camera personality can be cloned or uploaded into a camera in the event that a camera replacement is necessary.

### **Power Requirements**

The camera unit shall operate between 89 to 135 V(ac), 120 V(ac) nominal voltage and 50 or 60 Hz ( $\pm 3.0$  Hz). The camera unit shall meet the requirements of Section 2.1.6 "transients, power service" of the NEMA standard TS-2. The line variation and surge performance shall be tested to meet these specifications by an outside agency, other than the camera manufacturer. The tests shall be provided upon request. The power consumption shall not exceed a total of 200 watts, in which 100 watts for camera, receiver, pan/tilt driver and 100 watts for heater on.

### **Environmental Requirements**

The camera unit shall operate in ambient temperature range from -34 to +74 °C, in relative humidity up to 100 percent. The unit shall operate when exposure to sand, dust, fungus and salt atmosphere per MIL-E-5400T, and with shock for up to 10 Gs, 11 ms, in any axis under non-operating conditions, per MIL-E-5400T. The unit shall not be damaged with sine vibration from 5 to 30 Hz, 1/2 G, 3 axis in one hour.

### **HYBRID CAMERA CABLE AND CONNECTORS**

The hybrid camera cable (HCC) is applicable to both PTZ Camera Station and Fixed Camera Units. The Connectors are different for PTZ and the fixed cameras.

The hybrid camera cable (HCC) shall consist of one RG-59/U type analog video coaxial cable, one 6-No. 22 AWG conductor group, one 8-No. 26 AWG conductor group and a two twist pair 4-No. 26 AWG conductor group in a common outer jacket. The hybrid camera cable cross section is shown on the plans.

### Electrical Requirements

The coaxial cable shall conform to:

| Electrical                          | Coaxial    |
|-------------------------------------|------------|
| Capacitance (picofarads/ft nominal) | 17.3       |
| Impedance (ohms-nominal)            | 75         |
| Velocity of propagation (nominal)   | 78 percent |
| Nominal Diameter (inch)             | 0.242      |
| Insulation Rating                   | 300 V      |

The cable attenuation at 20 °C shall measure at maximum as:

| Frequency (MHz) | Nominal dB/ 100 ft |
|-----------------|--------------------|
| 1               | 0.30               |
| 10              | 0.90               |
| 50              | 2.10               |

The coaxial cable physical measurements:

| Component                              | Nominal OD (inches) |
|--|---------------------|
| Copper center conductor                | 0.040               |
| Foam polyethylene dielectric           | 0.180               |
| Sealed APA tape with 0.06-inch overlap | 0.216               |
| Woven aluminum braid                   | 0.241               |
| PVC outer jacket                       | 0.297               |

(APA = Aluminum polyolefin and aluminum with adhesive)

The 6-No. 22 AWG shall be stranded 7 x 30, tinned copper insulated with 0.009" nominal wall of S-R PVC and a nominal OD of 0.048". The 6 conductors shall be color coded as follows:

1. Black
2. Red
3. Green
4. White
5. Blue
6. Yellow

The 8-No. 26 AWG shall be stranded 7 x 34, tinned copper insulated with 0.009" nominal wall of S-R PVC and a nominal OD of 0.037". The 8 conductors shall be color coded as follows:

1. Brown
2. Blue
3. Orange
4. Yellow
5. Purple
6. Gray
7. White with Black Stripe
8. Red with Green Stripe

The 4-No. 26 AWG in 2 twisted pairs shall be stranded 7 x 34, tinned copper insulated with 0.009" nominal wall of S-R PVC and a nominal OD of 0.037". The 4 conductors shall be color coded as follows:

Pair No. 1:

1. Black
2. White

Pair No. 2:

3. Red
4. Green

The HCC shall also have a 36 AWG tinned copper braid with 90 percent coverage, an O/A binder of 0.001" polyester 25 percent overlap, and an outer jacket conforming to: color to match Fed-Std-595 color No. 24091, material 0.032" dark gray UV resistant PVC to 0.425" OD and must pass the VW-1 vertical flame test. Fillers shall be used as required to form a uniform round cable. The insulation rating of the overall cable jacket shall be 300 V.

The manufacture identification shall be surface printed in white ink every foot along the length of the cable.

The HCC shall be continuous from the CCTV (PTZ) camera unit to CCU and from a fixed camera unit to multiple camera termination unit (MCTU) in the controller cabinet without splicing, unless shown on the plan or approved by the Engineer. The maximum length of HCC is 750 feet.

For the CCTV (PTZ) camera unit, the HCC shall be terminated with cable connectors on both ends. Connector AMP 206036-3 with a full set crimp contact pins and strain relief back shell, AMP 206070-1 shall be installed on the cable end toward CCU. Connector AMP 206037-1 with a full set crimp contact sockets and strain relief back shell, AMP 206070-1 shall be installed on the cable end toward the CCTV (PTZ) camera unit. All connector contact shall be constructed with brass contact body material and with stainless steel spring that are sub-plated with 0.000050-inch nickel and plated with 0.000030-inch gold. Contact size shall be 16. AMP No. 305183 contact extraction tool shall be used to replace contact. AMP hand tool assembly 58495-1 with die assembly 58495-2 shall be used to place contacts on to each conductor. No other tool, unless approved by the Engineer will be used for this work.

For a fixed camera unit, the camera end of HCC shall be terminated with a cable connector AMP PT06A-14-18S (SR), which will mate with the connector on the fixed camera.

#### **Inspection and Testing Cable and Connectors**

Testing of HCC and connectors shall be performed in accordance with provisions in Section 86-2.14B, "Field Testing," of the Standard Specifications and these special provisions. Any cable lengths found to have faults shall be replaced and retested. The Contractor shall dispose of the removed faulty cable. The cable termination shall be randomly inspected for contact crimping quality control. Any contact found not crimped with the correct crimping tool and is defect shall be rejected. The Contractor shall redo the termination until all defects are corrected.

Prior to the beginning of work, the coaxial cable length of HCC shall be tested for attenuation and faults to ensure compliance with specifications contained herein using a time domain reflectometer (TDR). For the purpose of these special provisions, one or more of the following defines a fault in a long length of cable:

1. Return loss measurements indicating that attenuation exceeds 3 dB in the band from 5 MHz to 30 MHz in a portion of cable less than 10 feet long.
2. A return loss measurement indicating that there is a short in the cable.
3. A return loss measurement indicating a cut or open circuit in the cable.
4. A visual inspection that reveals exposure of or damage to the cable shielding.

#### **INTERFACE CABLES**

All interface cables when required to interface with other equipment as shown on the plan shall be minimum of 6 feet in length. All interface cables shall be commercially made high quality type with appropriate connectors on the cable ends as shown on the plans.

#### **Network Straight Through Data Cable**

The network straight through data cable shall be made of Ethernet twisted pair cable (ETPC) and terminated with an 8-conductor, 8P8C modular plug on both ends. ETPC shall consist of 4 unshielded twisted pair (UTP) No. 24 AWG stranded copper conductors insulated with high-density polyethylene (PE). The insulated conductors shall be tightly twisted into individual pairs and jacketed with PE or PVC.

### Video Patch Cable

The video patch cable shall be RG-59/U coaxial cable terminated at both end with BNC connectors. The coaxial cable shall conform to:

| Electrical                          | Coaxial    |
|-------------------------------------|------------|
| Capacitance (picofarads/ft nominal) | 17.3       |
| Impedance (ohms-nominal)            | 75         |
| Velocity of propagation (nominal)   | 78 percent |
| Nominal Diameter (inch)             | 0.242      |

The cable attenuation at 20 °C shall measure at maximum as:

| Frequency (MHz) | Nominal dB/ 100 ft |
|-----------------|--------------------|
| 1               | 0.30               |
| 10              | 0.90               |
| 50              | 2.1                |

The coaxial cable physical measurements:

| Component                              | Nominal OD (inches) |
|--|---------------------|
| Copper center conductor                | 0.040               |
| Foam polyethylene dielectric           | 0.146               |
| Sealed APA tape with 0.06-inch overlap | 0.216               |
| Bare copper braid                      | 0.241               |
| PVC outer jacket                       | 0.297               |

(APA = Aluminum polyolefin and aluminum with adhesive)

### TIA-232 Data Patch Cable

The TIA-232 data patch cable shall meet TIA-232 standard. The data cable shall have multiple No. 20 AWG conductors with (UL) Type CM shielded or AWM 2464 80C 300 Volts – C (UL). One end of data cable shall be terminated with a DE9 female connector. All contact socket pins shall be gold plated. The contact pin assignment is shown on the plans. The other end of the data cable shall be either terminated with an 8P8C modular plug or not terminated. When there is no connector required on the other end of cable, each conductor's insulation shall be stripped 1/4" long from the end of cable and the bare conductor shall be tinned with solder.

### CAMERA CONTROL UNIT

The Contractor shall install camera control units (CCU) and CCU to laptop PC cable at each CCTV (PTZ) camera station. The camera control units shall consist of a rack-mounted field unit. The camera control unit shall have the same manufacturer as the CCTV (PTZ) camera unit. The camera control unit shall be designed to provide on-site camera control functions. The control functions shall include pan/tilt positioning, zoom in/out control, auto/manual focus, and auto/manual iris.

The CCU shall include a local/remote switch that transfers control from the remote system to local. This shall allow the remote control system and the CCU to remain connected while transfer the control function without disconnection of the camera site equipment. The local function shall time-out and return to remote mode in 10 minutes.

The LED indicators on the CCU shall provide positive feedback of the automatic and manual mode status of the camera focus and iris functions, and the manual mode status of the pan/tilt function.

### Physical and Mechanical Requirements

Each CCU shall mount in 2 inches (1 rack unit) of EIA-310 rack space with a maximum depth of 14 inches. The front panel shall be black gloss color Number 17986 as per Federal Standard Color Chart 595B. The front and rear panel lettering shall be white color Number 17886 as per Federal Standard Color Chart 595B.

A high-impedance front and rear panel jack bayonet nut connector (BNC) shall be installed on the front and rear panel as shown on the plans. These connectors shall provide video input to a test monitor without affecting the remainder of the CCTV system. These connectors shall be directly monitoring the video input from the camera.



The connectors shall be of copper material with bright nickel (tarnish resistant) finish for the body and silver finish for the contact.

An automobile glass (AG), size 1/4" x 1-1/4", slow blow fuse shall be installed and replaceable from the outside of the unit.

Switches shall protrude no more than 0.5" from the front panel and shall be mounted as shown on the plans. Each switch shall be labeled as to their functions.

The rear panel connectors shall be mounted as shown on the plans and shall meet the following requirements:

1. Camera connector shall be of the following type or equivalent: AMP 206037-1, Square Flange type. The socket contacts for camera connector shall be constructed with brass contact body material and with stainless steel spring that are sub-plated with 0.000050-inch nickel and plated with 0.000030-inch gold. Contact size shall be No. 16. AMP No. 305183 contact extraction tool shall be used to replace contact.
2. The TIA-232 connectors shall be a DE9 pin connector and TIA-422 connector shall be a DE9 socket connector.
3. One mating connector, AMP 206036-3 with a full set crimp contact pins and strain relief back shell, AMP 206070-1 shall be supplied with each CCU supplied in the contract.

The Contractor shall provide all necessary interface cables for CCU to connect to all other camera equipment.

Each LED shall be High Intensity Untinted, Non-diffused LED. Each LED shall be mounted as shown on the plans.

An on/off switch to turn the CCU on/off shall be provided. An LED to indicate the AC power is on shall be provided.

Each CCU shall not weight more than 5 pounds.

## **Electrical Requirements**

### **Camera Control Functions**

Each CCU shall have circuitry to detect the absence and presence of video sync on its video input. Each CCU shall have auto-iris override. Each CCU shall have a transfer switch between local and remote mode. The local function shall time-out and return to the remote mode within 5 minutes. A system-reset switch with momentary-pushbutton type shall be mounted on the front panel to function as external reset input to the microprocessor. The system-reset shall exercise the pan and tilt movements through their ranges and return the camera to the prior position. The system-reset function shall allow remote execution.

The CCU shall have, as a minimum, control and drive circuits for the following camera control functions:

| <b>Control Function</b>   | <b>Switch Position</b>     |
|---|----------------------------|
| Pan momentary toggle switch   | Left-Stop-Right            |
| Tilt momentary toggle switch  | Up-Stop-Down               |
| Zoom In/Out momentary toggle switch   | Telephoto-Stop-Wide Angle  |
| Focus Automatic/Manual momentary toggle Switch  | Auto Focus -Manual         |
| Manual Focus toggle Switch  | Near-Stop-Far              |
| Iris Automatic/Manual toggle Switch   | Auto Iris -Manual Override |
| Manual Iris toggle Switch   | Open-Stop-Close            |
| Remote/Local momentary toggle Switch<br>(Local function shall time-out and return to remote mode in 10 minutes) | Remote-Local               |
| Reset momentary push button switch  | Reset                      |

Camera Connector Contact Assignment:

| Position | Function           | Position | Function           |
|----------|--------------------|----------|--------------------|
| 1        | Video, 75 $\Omega$ | 9        | Not Used           |
| 2        | Video Ground       | 10       | Not Used           |
| 3        | Data Ground        | 11       | Not Used           |
| 4        | Rx-                | 12       | 115 V(ac), Hot     |
| 5        | Rx+                | 13       | 115 V(ac), Neutral |
| 6        | Tx+                | 14       | Not Used           |
| 7        | Tx-                | 15       | 115 V(ac), Ground  |
| 8        | Not Used           | 16       | Not Used           |

#### TIA-232 Connector Contact Assignment (DE9 Pins):

| Position | Function          | Position | Function |
|----------|-------------------|----------|----------|
| 1        | Not Used          | 6        | Not Used |
| 2        | Receive Data, Rx  | 7        | RTS      |
| 3        | Transmit Data, Tx | 8        | CTS      |
| 4        | Not Used          | 9        | Not Used |
| 5        | Signal Ground     |          |          |

#### TIA-422 Connector Contact Assignment (DE9 Sockets):

| Position | Function      | Position | Function      |
|----------|---------------|----------|---------------|
| 1        | Tx+           | 6        | Signal Ground |
| 2        | Tx-           | 7        | Not Used      |
| 3        | Signal Ground | 8        | Not Used      |
| 4        | Rx+           | 9        | Not Used      |
| 5        | Rx-           |          |               |

#### Communication and Camera Addressing Protocol

The execution of CCU functions, other than the hardware controls on the front panel, shall be done through either TIA-232 or TIA-422 optically isolated serial communication ports on the back panel. A minimum 9,600-baud data rate shall be used. The CCU shall have a front panel TIA-232 port for connection to a local laptop computer. The (NTCIP) 1205 MIB communications protocol shall be included.

The communications between CCU and the CCTV (PTZ) camera unit shall be conducted through an TIA-422 circuit with full handshake support. A minimum 9,600-baud data rate shall be used. The CCU shall be 100 percent compatible with the protocol and data backbone architecture.

#### Power Consumption

The maximum power consumption for the CCU shall not exceed 45 W. Power consumption of equipment attached to CCU shall not exceed 250 W.

#### Environmental Requirements

Each CCU shall operate in an ambient temperature environment from -34 to +74 °C and up to 90 percent relative humidity. Each CCU shall pass 5 Gs, 11 ms, in any axis under non-operating conditions, MIL-E-5400T, Each CCU shall pass vibration tests:

1. Sine vibration from 5 to 60 Hz with 0.082-inch total excursion without damage.
2. Random vibration from 60 to 1,000 Hz, 5 Gs RMS (0.027-G<sup>2</sup>/Hz) without damage.

#### CCU to Laptop PC Cable

The Contractor shall install a universal serial bus (USB) to TIA-232 serial adapter at each PTZ camera location. The adapter shall have a DE9 socket connector for TIA-232 and Type A plug connector for USB. The Contractor shall also supply a 6 feet straight through USB extension cable. The USB function shall conform to version 2.0. The Contractor shall submit the adapter software in 1 GB Secure Digital (SD) memory card format.

#### MULTIPLE CAMERA TERMINATION UNIT

The Contractor shall install multiple camera termination unit (MCTUs) and MCTU to laptop PC cables at each fixed camera location as shown on the plans. The MCTU shall consist of a rack-mounted field unit. The MCTU shall be designed to provide camera power, camera control data and video output functions for minimum of four and maximum of eight fixed cameras attached.

#### Physical and Mechanical Requirements

Each MCTU shall mount in 2 inches (1 rack unit) of Electronic Components Association (ECA)-310 rack space with a maximum depth of 14 inches. The front panel shall be black gloss color Number 17986 as per Federal Standard Color Chart 595B. The front and rear panel lettering shall be white color Number 17886 as per Federal Standard Color Chart 595B.

A high-impedance front and rear panel jack bayonet nut connector (BNC) shall be installed on the front and rear panel as shown on the plans. These connectors shall provide video input to a test monitor without affecting the remainder of the CCTV system. These connectors shall be directly monitoring the video input from the camera. The connectors shall be of copper material with bright nickel (tarnish resistant) finish for the body and silver finish for the contact.

A automobile glass (AG), size 1/4" x 1 1/4" inches, slow blow 10 A fuse shall be installed and replaceable from the outside of the unit.

Power to each camera shall be controlled by a camera power on/off switch with power on LED indicator light and protected by a 1.5 A fuse. Switches shall protrude no more than 0.5-inch from the front panel and shall be mounted as shown on the plans. Each switch shall be labeled as to their functions.

The rear panel connectors shall be mounted as shown on the plans and shall meet the following requirements:

1. Camera connector shall be of the following type or equivalent: AMP 206037-1, Square Flange type. The socket contacts for camera connector shall be constructed with brass contact body material and with stainless steel spring that are sub-plated with 0.000050-inch nickel and plated with 0.000030-inch gold. Contact size shall be 16. AMP No. 305183 contact extraction tool shall be used to replace contact.
2. The TIA-232 connectors shall be a DB9 pin.
3. Eight mating connectors, AMP 206036-3 with full set crimp contact pins and strain relief back shell, AMP 206070-1 shall be supplied with each MCTU supplied in the contract.

The Contractor shall provide all necessary interface cables for MCTU to connect to all other camera equipment. Each LED shall be High Intensity Untinted, Non-diffused LED. Each LED shall be mounted as shown on the plans.

An main on/off switch to turn the MCTU on/off shall be provided. An LED to indicate the AC power is on shall be provided.

Each MCTU shall not weight more than 5 pounds.

### **Electrical Requirements**

MCTU camera connector contact assignment:

| Position | Function           | Position | Function           |
|----------|--------------------|----------|--------------------|
| 1        | Video, 75 $\Omega$ | 9        | Not Used           |
| 2        | Video Ground       | 10       | Not Used           |
| 3        | Data Ground        | 11       | Not Used           |
| 4        | Rx-                | 12       | 115 V(ac), Hot     |
| 5        | Rx+                | 13       | 115 V(ac), Neutral |
| 6        | Tx+                | 14       | Not Used           |
| 7        | Tx-                | 15       | 115 V(ac), Ground  |
| 8        | Not Used           | 16       | Not Used           |

MCTU TIA-232 connector contact assignment (DE9 Pins):

| Position | Function          | Position | Function |
|----------|-------------------|----------|----------|
| 1        | Not Used          | 6        | Not Used |
| 2        | Receive Data, Rx  | 7        | RTS      |
| 3        | Transmit Data, Tx | 8        | CTS      |
| 4        | Not Used          | 9        | Not Used |
| 5        | Signal Ground     |          |          |

MCTU shall have electronic circuitry to convert TIA-422 from camera connector to TIA-232 connector on the rear of the MCTU for external camera control functions.

### **Power Consumption**

The maximum power consumption for the MCTU shall not exceed 10 W. Power consumption of equipment attached to MCTU shall not exceed 800 W.

### Environmental Requirements

Each MCTU shall operate in an ambient temperature environment from –34 to +74 °C and up to 90 percent relative humidity. Each MCTU shall pass 5 Gs, 11 ms, in any axis under non-operating conditions, MIL-E-5400T, shock test. Each MCTU shall pass vibration tests:

1. Sine vibration from 5 to 60 Hz with 0.082-inch total excursion without damage.
2. Random vibration from 60 to 1,000 Hz, 5 Gs RMS (0.027-G<sup>2</sup>/Hz) without damage.

### MCTU to Laptop PC Cable

The Contractor shall provide a universal serial bus (USB) to TIA-232 serial adapter for each MCTU furnished in the contract to the Engineer. The adapter shall have a DE9 socket connector for TIA-232 and Type A plug connector for USB. The Contractor shall also supply a 6 feet straight through USB extension cable for each adapter. The USB function shall conform to version 2.0. The Contractor shall submit the adapter software in 1 GB Secure Digital (SD) memory card format.

### VIDEO ENCODER UNIT

A prototype of the video encoder unit (VEU) is not acceptable. All equipment shall be off-the-shelf production units. All equipment shall be new and not previously used. The Contractor shall provide a Service and Operation manual describing the operation, maintenance of the VEU for each unit provided in the contract. The Contractor shall provide all necessary interface cables to connect communication equipment and the camera control unit (CCU) for a complete and successful installation and operation of the VEU, and as shown on the plans.

### Abbreviations

|                |  |
|----------------|--|
| LED            | Light Emitting Diode                           |
| AC             | Alternating Current                            |
| SNMP           | Simple Network Management Protocol             |
| TELNET         | Network Virtual Terminal                       |
| CLI            | Command Line Interface                         |
| NTSC           | National Television System Committee           |
| SIF            | Source Input Format                            |
| QSIF           | Quarter Source Input Format                    |
| CIF            | Common Intermediate Format                     |
| QCIF           | Quarter Common Intermediate Format             |
| BNC            | Bayonet Nut Connector                          |
| RJ             | Registered Jack                                |
| IP             | Internet Protocol                              |
| DHCP           | Dynamic Host Configuration Protocol            |
| bps            | Bits Per Second                                |
| fps            | Frame Per Second                               |
| MPEG           | Motion Picture Experts Group                   |
| ISO            | International Organization for Standardization |
| IEC            | International Electrotechnical Commission      |
| DiffServ (QoS) | DIFFerentiated SERVices (Quality Of Service)   |
| UDP            | User Datagram Protocol                         |
| RTP            | Real-time Transport Protocol                   |
| RTSP           | Real Time Streaming Protocol                   |
| RTCP           | Real-time Transport Control Protocol           |
| HTTP           | HyperText Transfer Protocol                    |
| MIL            | MILitary                                       |

### Physical and Mechanical Requirements

The VEU shall be mountable in a standard TIA-310 equipment rack or can be a stand-alone unit which shall be mounted to a standard TIA-310 equipment shelf. The VEU and shelf if any shall fit in 5.25 inches of a standard TIA-310 equipment rack space. Each VEU shall have all the cable connections on the rear of the unit. A main power switch to turn the unit on/off shall be provided. An LED to indicate the AC power on shall be provided.

### Electrical Requirements

The VEU shall be able to be remotely managed, configured and maintained without the use of any third party software with the management and performed using SNMP, TELNET and CLI. The VEU shall operate with both color and black/white video input signal without modification to the hardware. The VEU shall be compatible with existing video management systems.

The input video resolution of the VEU shall be the following:

| Video Resolution | NTSC      |
|------------------|-----------|
| SIF              | 352 x 240 |
| QSIF             | 176 x 128 |
| CIF              | N/A       |
| QCIF             | N/A       |
| Custom           | 64 x 48   |
| Custom           | 128 x 96  |
| Custom           | 192 x 144 |
| Custom           | 256 x 192 |
| Custom           | 352 x 240 |

The input video formats of the VEU shall be composite NTSC with 525 lines at 60 Hz. The VEU shall have a minimum of two composite video input channels. The input video connector shall be compatible with SMPTE-170M at 75  $\Omega$  impedance with Bayonet Nut Connector (BNC) type.

The network communication interface of the VEU shall be Ethernet 10/100 Mbps through 8P8C connector port, either in static IP or assigned through DHCP.

The camera control data interface shall include a maintenance serial port for local maintenance and a control serial Port for Data transport. The port shall be TIA-232 at a user selectable data rate from 1,200 to 20,000 bps, asynchronous. The connector type for the port shall be a DE9 pin type.

The VEU shall provide bandwidth for camera control within the bandwidth allocated for video only when bandwidth is needed for camera control/status data transmission.

The video compression of the VEU shall meet MPEG 4-ISO/IEC 14496-2 standard and H.264 standard. The MPEG-4 compliant levels are:

1. Level 1 – up to 64 kbps
2. Level 2 – up to 128 kbps
3. Level 3 – up to 384 kbps

The video rates of the VEU shall be scaleable from 1 fps to 30 fps and from 8 kbps to 2 Mbps. User selectable options are:

1. Constant bit rate at constant frame rate
2. Variable bit rate at constant frame rate
3. Constant bit rate at variable frame rate

The video delivery options of the VEU are either unicast or multicast with protocols DiffServ (QoS), UDP, IP, RTP, RTSP, RTCP, HTTP, SNMP, and TELNET.

### Power Requirements

The VEU shall operate from 89 to 135 V(ac), 120 V(ac) nominal voltage and 50 or 60 Hz ( $\pm 3.0$  Hz). The VEU shall meet the requirements of Section 2.1.6 "Transients, Power Service," of the NEMA standard TS-2. The line variation and surge performance shall be tested to meet these specifications by an outside agency, other than the VEU manufacturer. The test results shall be provided upon request. The power consumption shall not exceed a total 25 watts.

### Environmental Requirements

Each VEU shall operate in an ambient temperature environment range from  $-20$  to  $+70$   $^{\circ}\text{C}$  and up to 90 percent relative humidity. Each VEU shall pass 5 Gs, 11 ms, in any axis under non-operating conditions, MIL-E-5400T shock test. Each VEU shall pass vibration tests:

1. Sine vibration from 5 to 60 Hz with 0.082-inch total excursion without damage

2. Random vibration from 60 to 1,000 Hz, 5 G's RMS ( $0.027\text{-G}^2/\text{Hz}$ ) without damage

### **EQUIPMENT SHELF WITH BRACKETS**

The Contractor shall furnish and install each equipment shelf as shown on the plans.

Each shelf shall be attached to the top of 2 steel supporting angles with 4 screws. Each angle shall conform to the provisions in Section 6.3.4 of the TEES. Each angle shall extend from the front to the back rails. The front of the shelf shall abut the front member of the mounting cage.

Each shelf shall be constructed of 0.125 inch cold rolled steel or aluminum sheet with a depth of 21 inches and a minimum width of 17 inches. Each shelf shall have equally distributed holes or slots providing 40 percent open area for vertical flow-through ventilation. Each hole or slot shall not exceed 0.75 square inches in area. Steel shelves shall be cadmium- or zinc-plated after cutting and drilling.

### **RACK-MOUNT POWER STRIP**

#### **Electrical**

Each rack-mount power strip shall meet the following requirements:

1. A maximum rating of 15 A, 120 V(ac), 60 Hz.
2. A surge protection with UL 1449 Clamping Level of 400 V, an IEEE Let-Through Voltage rating of less than 336 V, a single-pulse energy rating of 210 J and EMI/RFI noise protection rating of 40 dB.
3. One 15 A circuit breaker.
4. One internally illuminated switch to cut off power to all outlets.
5. Six NEMA 5-15R outlets.

#### **Mechanical**

Each rack-mount power strip shall meet the following requirements:

1. Dimensions of 2" (H) x 19" (W) x 2-4/5" (D) maximum and shall not weigh more than 4.5 pounds.
2. The front plate of the rack-mount power strip shall have two cut-off mounting screw holes on each end.
3. Each outlet shall have 1-1/2" minimum spacing center-to-center to its adjacent outlet.
4. The power cord shall enter from the rear with a length of 7 feet minimum.
5. The clearance between the power cord entrance and the nearest outlet shall be 3-3/8" minimum.
6. Both the circuit breaker and the switch shall be front-mounted.
7. Each outlet shall be rear-mounted.

The rack-mount power strip shall be plugged into the non-GFCI duplex outlet normally labeled with "Controller Unit Receptacle" in the back of the Power Distribution Assembly (PDA). The rack-mount power strip shall be mounted on the rear of the standard ECA-310 rack cage and across the two vertical back rails with four stainless steel mounting screws, two on each side. The rack-mount power strip shall not hinder the accessibility to the back of all existing electrical equipment. All power cords for permanently field installed electrical equipment shall be plugged into the power strip.

### **TOS SERVICE MANUAL**

The Contractor shall provide to the Engineer a minimum of 3 copies of service manuals for the CCTV (PTZ) camera unit, fixed camera unit, camera control unit (CCU), multiple camera termination unit (MCTU), video encoder unit (VEU) under this special provisions. Each manual shall contain the following sections and sub-sections.

#### **General Information**

1. A list of applicable subassemblies that comprise the specified equipment
2. Overall description of the equipment design features (including all enhance features if applicable), performance, and applications
3. Equipment specifications summary
4. Equipment installation instructions

#### **Theory of Operations**

1. Theory of operation of the standard equipment, with unique or unusual circuitry described in detail
2. Theory of operation reflecting any modifications to the standard equipment

### **Maintenance**

1. Recommended test equipment and fixtures, or minimum operational and performance requirements for appropriate test equipment
2. Trouble shooting information and charts
3. Removal and installation procedures for replacing assemblies and subassemblies, if not obvious or if improper sequencing of steps may result in component damage

### **Replacement Parts**

1. Each manual shall contain an equipment replacement parts list including electrical parts, mechanical parts and assemblies.
2. All semiconductors shall be identified by the supplier's numbers and by Joint Electron Device Council (JEDEC) numbers if applicable.

### **Diagram**

1. Schematic diagram(s) identifying all circuit components and showing normal test voltages and levels
2. An overall functional block diagram
3. Detailed interconnecting diagram(s) showing wiring between modules, circuit boards and major components
4. Pictorial circuit board layout diagram(s) showing both component placement and printed wiring detail
5. Diagram(s) showing location of circuit boards and other subassemblies
6. Exploded view diagram(s) of complex mechanical assemblies

### **Physical Requirements**

1. All pages, including latest revisions, shall be securely fastened together between protective covers (loose-leaf ring binding is acceptable).
2. No page shall be subject to fading from exposure to any normal source of ambient lighting (ozalid reproduced pages are not acceptable).

## **10-3.18 FIBER OPTIC SYSTEM**

### **GENERAL**

#### **Summary**

The work includes installing the fiber optic system as specified in these special provisions and as shown on the plans.

Fiber optic system shall consist of:

1. Fiber Optic Cable
2. Flexible Fiber Optic Cable
3. Fiber Optic Conduit System
4. Flexible Fiber Optic Transmitters and Receivers

#### **Definitions**

**Breakout:** The cable "breakout" is produced by:

1. Removing the jacket just beyond the last tie-wrap point,
2. Exposing 3 to 6 feet of the cable buffers, aramid strength yarn and central fiberglass strength member, and
3. Cutting aramid yarn, central strength member and the buffer tubes to expose the individual glass fibers for splicing or connection to the appropriate device.

**Connector:** A mechanical device used to align and join two fibers together to provide a means for attaching to and decoupling from a transmitter, receiver, or another fiber (i.e., patch panel).

**Connectorized:** Termination point of a fiber after connectors have been affixed.

**Connector Module Housing (CMH):** A patch panel used in the FDU to terminate singlemode fibers with most common connector types. It may include a jumper storage shelf and a hinged door.

**Couplers:** Devices which mate two fiber optic connectors to facilitate the transition of optical light signals from one connector into another. Couplers may also be referred to as: adapters, feed-throughs, and barrels.

They are normally located within FDUs mounted in panels. They may also be used unmounted, to join two simplex fiber runs.

**End-to-End Loss:** The maximum permissible end-to-end system attenuation is the total loss in a given link. This loss could be the actual measured loss, or calculated using typical (or specified) values. A designer should use typical values to calculate the end-to-end loss for a proposed link. This number will determine the amount of optical power (in dB) needed to meet the System Performance Margin.

**Fan Out Termination:** Permits the branching of fibers contained in an optical cable into individual cables and can be done at field locations; thus, allowing the cables to be connectorized or terminated per system requirements. A kit provides pull-out protection for individual bare fibers to support termination. It provides three layers of protection consisting of a Teflon inner tube, a dielectric strength member, and an outer protective PVC jacket.

**FBC:** Fiber Backbone Cable.

**Fiber Distribution Unit (FDU):** An rack mountable enclosure containing both a Connector Module Housing (CMH) and a Splice Module Housing (SMH).

**Fiber Storage Enclosure (FSE):** Designed for holding excess cable slack for protection. The FSE allows the user flexibility in equipment location and the ability to pull cable back for resplicing.

**FO:** Fiber optic.

**FOIP:** Fiber optic inside plant cable.

**FOOP:** Fiber optic outside plant cable.

**FOTP:** Fiber optic test procedure(s) as defined by ANSI EIA/TIA standards.

**FPC:** Fiber pigtail drop cable

**FTC:** Fiber trunkline cable

**Light Source:** A portable fiber optic test equipment that, in conjunction with a power meter, is used to perform end-to-end attenuation testing. It contains a stabilized light source operating at the designed wavelength of the system under test. It also couples light from the source into the fiber to be received at the far end by the receiver.

**Link:** A passive section of the system, the ends of which are to be connectorized to active components. A link may include splices and couplers. For example, a video data link may be from video FO transmitter to video FO receiver.

**Link Loss Budget:** A calculation of the overall permissible attenuation from the fiber optic transmitter (source) to the fiber optic receiver (detector).

**Loose Tube Cable:** Type of cable construction in which fibers are placed in buffer tubes to isolate them from outside forces (stress). A flooding compound or material is applied to the interstitial cable core to prevent water migration and penetration. This type of cable is primarily for outdoor applications.

**Mid-span Access Method:** Description of a procedure in which fibers from a single buffer tube are accessed and spliced to an adjoining cable without cutting the unused fibers in the buffer tube, or disturbing the remaining buffer tubes in the cable.

**MMFO:** Multimode fiber optic cable

**OFNR:** Optic fiber non-conductive riser

**Optical Time Domain Reflectometer (OTDR):** A fiber optic test equipment (similar in appearance to an oscilloscope) that is used to measure the total amount of power loss between two points and over the corresponding distance. It provides a visual and printed display of the relative location of system components such as fiber sections, splices and connectors as well as the losses that are attributed to each component and or defects in the fiber.

**Patch cord:** A short jumper used to join two components.

**Pigtail:** Relatively short length of fiber optic cable that is connectorized on only one end. All pigtails shall be tight buffer cable.

**Power Meter:** A portable fiber optic test equipment that, when coupled with a light source, is used to perform end-to-end attenuation testing. It contains a detector that is sensitive to light at the designed wavelength of the system under test. Its display indicates the amount of power injected by the light source that arrives at the receiving end of the link.

**Segment:** A section of fiber optic cable that is not connected to any active device and may or may not have splices per the design.

**SM:** Singlemode

**SMFO:** Singlemode Fiber Optic Cable.

**Splice:** The permanent joining of fiber ends to identical or similar fibers.

**Splice Enclosure:** An environmentally sealed container used to organize and protect splice trays. The container allows splitting or routing of fiber cables from and to multiple locations.

**Splice Module Housing (SMH):** Stores splice trays as well as pigtails and short cable lengths.



**Splice Tray:** A container used to organize and protect spliced fibers.

**Splice or Fiber Optic Vault:** An underground container used to house excess cable and splice enclosures.

**System Performance Margin:** A calculation of the overall "End to End" permissible attenuation from the fiber optic transmitter (source) to the fiber optic receiver (detector). The system performance margin should be at least 6 dB. This includes the difference between the active component link loss budget, the passive cable attenuation (total fiber loss) and the total connector/splice loss.

**Tight Buffer Cable:** Type of non-breakout cable construction where each glass fiber is tightly buffered (directly coated) with a protective thermoplastic coating to 900 µm with the exception of the protective thermoplastic coating. The tight buffer cable shall meet all the characteristics of the fiber in the fiber optic outside plant cable specified elsewhere in these specifications.

## **FIBER OPTIC CABLE**

### **General**

Each fiber optic cable for this project shall be all dielectric, gel filled, duct type, with loose buffer tubes construction with a maximum outside diameter of 0.55 inch and shall conform to these special provisions. Cables shall contain singlemode (SM) dual-window (1310 nm and 1550 nm) fibers with the numbers specified below and as shown on the plans:

|                                |              |
|--------------------------------|--------------|
| Fiber trunkline cable (FTC-96) | 96 SM fibers |
| Fiber trunkline cable (FTC-72) | 72 SM fibers |
| Fiber trunkline cable (FTC-48) | 48 SM fibers |
| Fiber pigtail drop cable (FPC) | 12 SM fibers |

The optical fibers shall be contained within loose buffer tubes. The loose buffer tubes shall be stranded around an all dielectric central member. Aramid yarn shall be used as a primary strength member, and a polyethylene outside jacket shall provide for overall protection.

All cables for each specific FO cable type shall be from the same manufacturer.

The cable shall be compliant with Chapter XV11, Title 7, Part 1755.900 of the Code of Federal Regulations, "REA Specification for Filled Fiber Optic Cables."

The change in attenuation of FO cable at operational temperatures from -40 to +70 °C shall not exceed 0.20 dB/km, with 80 percent of the measured values at or below 0.10 dB/km. The attenuation shall be measured at 1550 nm in accordance with TIA-455-3A (FOTP-3), "Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components."

### **FO Cable Components**

FO cable shall consist of:

1. Fiber
2. Buffer tubes
3. Central member
4. Filler rods
5. Stranding
6. Core and cable flooding
7. Tensile strength member
8. Ripcord
9. Outer jacket

### **Fiber**

Each optical fiber shall be made of glass and consists of a doped silica core surrounded by concentric silica cladding. All fibers in the buffer tube shall be usable fibers, and shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of these specifications. The required fiber grade shall reflect the maximum individual fiber attenuation, to guarantee the required performance of each and every fiber in the cable.

The coating shall be a dual layered, UV cured acrylate and shall be mechanically strippable without damaging the fiber.

Singlemode fibers within the finished cable shall have the following characteristics over an operating temperature range from -40 to +70 °C:

Fiber Characteristics Table

| Parameters  | Characteristic   |
|---|--|
| Type  | Step Index   |
| Core diameter   | 8.3 µm (nominal)   |
| Cladding diameter   | 125 µm ±1.0 µm   |
| Core to Cladding Offset   | ≤1.0 µm  |
| Coating Diameter  | 250 µm ±15 µm  |
| Cladding Non-circularity<br>defined as: $[1 - (\text{Min cladding Dia} \div \text{Max cladding Dia})] \times 100$ | ≤2.0 percent   |
| Proof/Tensile Test  | 50 kpsi, Min   |
| Attenuation:<br>at 1310 nm<br>at 1550 nm  | ≤0.4 dB/km<br>≤0.4 dB/km   |
| Attenuation at the Water Peak   | ≤2.1 dB/km @ 1383 ±3 nm  |
| Bandwidth:<br>at 850 nm<br>at 1310 nm (SM)  | N/A<br>N/A   |
| Chromatic Dispersion:<br>Zero Dispersion<br>Wavelength<br>Zero Dispersion Slope                                   | 1301.5 to 1321.5 nm<br>≤0.092 ps/(nm <sup>2</sup> *km)                 |
| Maximum Dispersion:   | ≤3.3 ps/(nm*km) for<br>1285 - 1330 nm<br><18 ps/(nm*km) for<br>1550 nm |
| Cut-Off Wavelength  | <1250 nm   |
| Mode Field Diameter<br>(Petermann II)   | 9.3 ±0.5 µm at 1300 nm<br>10.5 ±1.0 µm at 1550 nm                      |

Each fiber shall be distinguishable from others in the same tube by means of color coding according to the following:

|                |                 |
|----------------|-----------------|
| 1. Blue (BL)   | 7. Red (RD)     |
| 2. Orange (OR) | 8. Black (BK)   |
| 3. Green (GR)  | 9. Yellow (YL)  |
| 4. Brown (BR)  | 10. Violet (VL) |
| 5. Slate (SL)  | 11. Rose (RS)   |
| 6. White (WT)  | 12. Aqua (AQ)   |

The colors shall be targeted in accordance with the Munsell color shades and shall meet EIA/TIA-598 "Color Coding of Fiber Optic Cables."

The color formulation shall be compatible with the fiber coating and the buffer tube filling compound, and be heat stable. It shall not fade or smear or be susceptible to migration and it shall not affect the transmission characteristics of the optical fibers and shall not cause fibers to stick together.

#### Buffer Tubes

Clearance shall be provided in the loose buffer tubes between the fibers and the inside of the tube to allow for expansion without constraining the fiber. The fibers shall be loose or suspended within the tubes. The fibers shall not adhere to the inside of the buffer tube. Each buffer tube shall contain up to 12 fibers.

The loose buffer tubes shall be extruded from a material having a coefficient of friction sufficiently low to allow free movement of the fibers. The material shall be tough and abrasion resistant to provide mechanical and

environmental protection of the fibers, yet designed to permit safe intentional "scoring" and breakout, without damaging or degrading the internal fibers.

Buffer tube shall contain a water-swellaable yarn or a homogeneous hydrocarbon-based gel with anti-oxidant additives for water migration resistance. The filling compound shall be non-toxic and dermatologically safe to exposed skin. It shall be chemically and mechanically compatible with all cable components, non-nutritive to fungus, non-hygroscopic and electrically non-conductive. The filling compound shall be free from dirt and foreign matter and shall be readily removable with conventional nontoxic solvents.

Buffer tubes shall be stranded around a central member by a method that will prevent stress on the fibers when the cable jacket is placed under strain, such as the reverse oscillation stranding process.

Buffer tubes containing fibers shall also be color coded with distinct and recognizable colors according to the following:

|                |               |
|----------------|---------------|
| 1. Blue (BL)   | 5. Slate (SL) |
| 2. Orange (OR) | 6. White (WT) |
| 3. Green (GR)  | 7. Red (RD)   |
| 4. Brown (BR)  | 8. Black (BK) |

Colors shall be as specified for fiber coding.

#### **Central Member**

The central member which functions as an anti-buckling element shall be a glass reinforced plastic rod with similar expansion and contraction characteristics as the optical fibers and buffer tubes. A linear overcoat of low density polyethylene shall be applied to the central member to achieve the optimum diameter to provide the proper spacing between buffer tubes during stranding.

#### **Filler rods**

Filler rods may be included in the cable to maintain the symmetry of the cable cross-section. Filler rods shall be solid medium or high density polyethylene. The diameter of filler rods shall be the same as the outer diameter of the buffer tubes.

#### **Stranding**

Completed buffer tubes shall be stranded around the overcoated central member using stranding methods, lay lengths and positioning such that the cable shall meet mechanical, environmental and performance specifications. A polyester binding shall be applied over the stranded buffer tubes to hold them in place. Binders shall be applied using tension sufficient to secure the buffer tubes to the central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking (or rendered so by the flooding compound), and dielectric with low shrinkage.

#### **Core and Cable Flooding**

The cable core interstices shall be filled with a polyolefin based compound to prevent water ingress and migration. The flooding compound shall be homogeneous, non-hygroscopic, electrically non-conductive, and non-nutritive to fungus. The compound shall also be nontoxic, dermatologically safe and compatible with all other cable components.

#### **Tensile Strength Member**

Tensile strength shall be provided by high tensile strength aramid yarns or fiberglass which shall be helically stranded evenly around the cable core and shall not adhere to other cable components.

#### **Ripcord**

The cable shall contain at least one ripcord under the jacket for easy sheath removal.

#### **Outer Jacket**

The jacket shall be free of holes, splits, and blisters and shall be medium or high density polyethylene (PE), or medium density cross-linked polyethylene with minimum nominal jacket thickness of 0.04 in. Jacketing material shall be applied directly over the tensile strength members and flooding compound and shall not adhere to the aramid strength material. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

The jacket or sheath shall be marked with the manufacturer's name, the words "Optical Cable", the number of fibers, "SM", year of manufacture, and sequential measurement markings every meter. The actual length of the cable shall be within -0/+1 one percent of the length marking. The marking shall be in a contrasting color to the cable jacket. The height of the marking shall be approximately 0.1 inch.

#### **FO Cable Environmental and Mechanical Requirements**

FO cable shall withstand water penetration when tested with a 3 feet static head or equivalent continuous pressure applied at one end of a 3 feet length of filled cable for one hour. No water shall leak through the open cable end. Testing shall be done in accordance with TIA-455-82 (FOTP-82), "Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable."

A representative sample of cable shall be tested in accordance with TIA-455-81A, "Compound Flow (Drip) Test for Filled Fiber Optic Cable." The test sample shall be prepared in accordance with Method A. The cable shall exhibit no flow (drip or leak) at 80 °C as defined in the test method.

Crush resistance of the finished FO cables shall be 115 lb/in applied uniformly over the length of the cable without showing evidence of cracking or splitting when tested in accordance with TIA-455-41 (FOTP-41) "Compressive Loading Resistance of Fiber Optic Cables." The average increase in attenuation for the fibers shall be  $\leq 0.10$  dB at 1550 nm for a cable subjected to this load. The cable shall not exhibit any measurable increase in attenuation after removal of load. Testing shall be in accordance with TIA-455-41 (FOTP-41), except that the load shall be applied at the rate of 0.12 to 0.74 inch per minute and maintained for 10 minutes.

FO cable shall withstand 25 cycles of mechanical flexing at a rate of  $30 \pm 1$  cycles/minute. The average increase in attenuation for the fibers shall be  $\leq 0.20$  dB at 1550 nm at the completion of the test. Outer cable jacket cracking or splitting observed under 10 times magnification shall constitute failure. The test shall be conducted in accordance with TIA-455-104 (FOTP-104), "Fiber Optic Cable Cyclic Flexing Test," with the sheave diameter a maximum of 20 times the outside diameter of the cable. The cable shall be tested in accordance with Test Conditions I and II of (FOTP-104).

Impact testing shall be conducted in accordance with TIA-455-25 (FOTP-25) "Impact Testing of Fiber Optic Cables and Cable Assemblies." The cable shall withstand 20 impact cycles. The average increase in attenuation for the fibers shall be  $\leq 0.20$  dB at 1550 nm. The cable jacket shall not exhibit evidence of cracking or splitting.

The finished FO cable shall withstand a tensile load of 600 pound-force without exhibiting an average increase in attenuation of greater than 0.20 dB. The test shall be conducted in accordance with TIA-455-33 (FOTP-33), "Fiber Optic Cable Tensile Loading and Bending Test." The load shall be applied for one-half hour in Test Condition II of the TIA-455-33 (FOTP-33) procedure.

#### **FO Cable Packaging and Shipping Requirements**

The completed FO cable shall be packaged for shipment on reels. The cable shall be wrapped in a weather and temperature resistant covering. Both ends of the cable shall be sealed to prevent the ingress of moisture.

Each end of the FO cable shall be securely fastened to the reel to prevent the cable from coming loose during transit. Two meters of cable length on each end of the cable shall be accessible for testing.

Each cable reel shall have a durable weatherproof label or tag showing the manufacturer's name, the cable type, the actual length of cable on the reel, the Contractor's name, the contract number, and the reel number. A shipping record shall be provided to the Engineer in a weatherproof envelope showing the above information and also include the date of manufacture, cable characteristics (size, attenuation, bandwidth, etc.), factory test results, cable identification number and other pertinent information.

The minimum hub diameter of the reel shall be at least thirty times the diameter of the cable. The FO cable shall be in one continuous length per reel with no factory splices in the fiber. Each reel shall be marked to indicate the direction the reel should be rolled to prevent loosening of the cable.

Installation procedures and technical support information shall be furnished at the time of delivery.

#### **FLEXIBLE FIBER OPTIC CABLE**

Flexible fiber optic cable (FFOC) shall be tight buffered construction with a maximum outside diameter of 0.2 inch and shall conform to these special provisions. Cables shall contain 2 singlemode dual-window, 1310 nm and 1550 nm, fibers.

The optical fibers shall be contained within loose buffer tubes. The loose buffer tubes shall be stranded around an all dielectric central member. Aramid yarn shall be used as a primary strength member, and a polyethylene outside jacket shall provide for overall protection.

All cables for each specific FFOC type shall be from the same manufacturer.

FFOC shall comply with the optical and mechanical requirements over an operating temperature range from -40 to +70 °C specified in EIA-455-33 (FOTP-33).

The change in attenuation of FFOC at operational temperatures from -40 to +70 °C shall not exceed 0.40 dB/km. The attenuation shall be measured at 1550 nm in accordance with EIA-455-3A (FOTP-3), "Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components."

#### **FFOC components**

FFOC shall consist of:

1. Optical Fiber
2. Synthetic Yarn Strength Member
3. Protective Outer Jacket

#### **FFOC Fiber**

Each optical fiber shall be glass and consist of a doped silica core surrounded by concentric silica cladding. All fibers shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of these specifications. The required fiber grade shall reflect the maximum individual fiber attenuation, to guarantee the required performance of each and every fiber in the cable.

The coating shall be a dual layered, UV cured acrylate. The coating shall be mechanically strippable without damaging the fiber.

Singlemode fibers within the finished FFOC shall meet the requirements in the following table:

FFOC Fiber Characteristics Table

| Parameters                               | Characteristic             |
|--|----------------------------|
| Type                                     | OFNR                       |
| Core diameter                            | 8.3 μm (nominal)           |
| Cladding diameter                        | 125 nm                     |
| Proof/Tensile Test                       | 50 kpsi, Min               |
| Attenuation:<br>at 1310 nm<br>at 1550 nm | ≤0.40 dB/km<br>≤0.30 dB/km |
| Bandwidth:<br>at 1310 nm<br>at 1550 nm   | N/A<br>N/A                 |

Each fiber shall be distinguishable from others by means of color coding according to the following:

|                |                 |
|----------------|-----------------|
| 1. Blue (BL)   | 7. Red (RD)     |
| 2. Orange (OR) | 8. Black (BK)   |
| 3. Green (GR)  | 9. Yellow (YL)  |
| 4. Brown (BR)  | 10. Violet (VL) |
| 5. Slate (SL)  | 11. Rose (RS)   |
| 6. White (WT)  | 12. Aqua (AQ)   |

The colors shall be targeted in accordance with the Munsell color shades and shall meet EIA/TIA-598 "Color Coding of Fiber Optic Cables."

The color formulation shall be compatible with the fiber coating and the buffer tube filling compound, and be heat stable. It shall not fade or smear or be susceptible to migration and it shall not affect the transmission characteristics of the optical fibers and shall not cause fibers to stick together.

The optical fibers shall be surrounded by a primary polymer buffer and a tight-fitting secondary polymer buffer with diameter of 900 μm.

#### **Synthetic Yarn Strength Member**

The synthetic waterblocking yarn strength member shall be helically laid directly over the stranded cable core. The strength member shall be composed of individually and precisely tensioned elements such that tensile loads are equaled by each element.

### **Protective Outer Jacket**

The protective outer jacket shall be free of holes, splits, and blisters and shall be flame retardant polyvinylchloride (PVC) and orange in color with minimum nominal jacket thickness of 0.04 inch. Jacketing material shall be applied directly over the tensile strength members and shall not adhere to the aramid strength material.

FFOC jacket markings shall be as specified for FO cable.

### **FFOC Mechanical Requirements**

Requirements for FFOC resistance to crush, mechanical flexing, impact, and tensile loading shall be as specified for FO cable.

### **FFOC Packaging and Shipping**

Packaging and shipping of FFOC shall be as specified for FO cable.

## **FIBER OPTIC CONDUIT SYSTEM**

Fiber optic conduit system shall consist of:

1. FO conduit
2. Innerduct
3. Conduit sealing plugs
4. Concrete backfill, warning tape, and cable markers for installation in open trench
5. Communication conduit anchors for installation on concrete structures
6. FO pull boxes
7. FO vaults

### **Fiber Optic Conduit**

Fiber optic conduit shall be as shown on the plans and as specified in Section 86-2.05, "Conduit," of the Standard Specifications.

### **Innerduct**

Innerduct shall be as shown on the plans and specified in these special provisions. A separate pull tape conforming to the provisions in Section 86-2.05C, "Installation," of Standard Specifications shall be installed in each innerduct.

Innerduct shall be made of one of the following:

1. An extruded flexible, smooth or ribbed high density polyethylene (HDPE) tubing
2. Fabric mesh pouch

Innerduct within a conduit run shall be continuous without splices or joints.

Unless otherwise shown on the plans, innerduct for new conduit shall be nominal 1.0 inch inside diameter with wall thickness of  $0.0906 \pm 0.003$  inch, and shall meet the following requirements:

- A. Polyethylene for innerduct shall have a density of  $59.6187 \text{ lb/ft}^3 \pm 0.3121 \text{ lb/in}^3$  (ASTM Designation: D 1505) and shall conform to the applicable requirements of ASTM Designation: D 3485, D 3035, D 2239, and D 2447, and the applicable requirements of NEMA TC7 and TC2
- B. Tensile yield strength shall be 3300 psi minimum in accordance with the requirements in ASTM Designation: D 638
- C. Innerduct shall be color coded in accordance with the cable type:
  1. Type A – black
  2. Type B – orange
  3. Type C – yellow
  4. Type D – blue

The innerducts shall be shipped on reels marked with the manufacturer's name, contract number, and the size and length of the innerduct. The product on reels shall be covered with aluminized material to protect colors from UV deterioration during shipment and storage.

Installation procedures shall be as specified by the innerduct manufacturer.

### **Conduit Sealing Plugs**

Except when otherwise noted, all fiber optic conduits shall have their ends sealed with commercially available preformed plugs.

Sealing plugs shall be removable and reusable. Plugs shall be the split type that permits installation or removal without removing cables. Sealing plugs shall consist of one self contained assembly. The assembly shall include an adjustable resilient filler of neoprene or silicone rubber clamped between backing ends and compressed with stainless steel hardware.

Neoprene or silicone adapting sleeves shall be inserted to seal an opening in the plug body when cable diameter is smaller than port diameter.

Unused ports in the plug body shall be sealed with neoprene or silicone plugs fitting the port opening.

Sealing plugs shall be capable of withstanding a pressure of 5 psi.

A plug sealing an empty conduit shall be attached to the pull tape.

### **Concrete Backfill**

Concrete backfill shall conform to the provisions in Section 86-2.05C, "Installaton," of Standard Specifications and these special provisions.

The concrete backfill shall be colored by a coloring agent specifically manufactured for coloring concrete. The coloring agent shall be fine ground, synthetic mineral oxide and shall be uniformly and homogeneously mixed with the concrete.

The color of the concrete backfill after curing and when air dry shall be red conforming to Color No. 31105 of Federal Standard No. 595B.

For trenches in paved areas, only the top 4 inch of concrete backfill shall be pigmented concrete. At the option of the Contractor, the full depth may have the pigment.

### **Warning Tape**

Warning tape shall be furnished, and installed in the trench over new conduits for fiber optic cable as shown on the plans.

The warning tape must have:

| DESCRIPTION                           | PARAMETERS  |
|---------------------------------------|---|
| Thickness                             | Minimum 4 mil   |
| Width                                 | 4 inches  |
| Material                              | Orange color polyolefin film  |
| Tensile strength of material          | Minimum of 2800 psi   |
| Elongation                            | Minimum of 500 percent elongation before breakage                         |
| Printed message content               | CAUTION: BURIED FIBER OPTIC CABLE -<br>CALTRANS RADIO ROOM (510) 286-4444 |
| Printed message text height and color | 1 inch, black color text over bright orange background                    |
| Message spacing intervals             | 3 feet  |

The printed warning shall not be removed by the normal handling and burial of the tape and must be rated to last the service life of the tape.

Warning tape shall not delaminate when it is wet. It must be resistant to insects, acid, alkaline and other corrosive elements in the soil.

Warning tape shall be as manufactured by Condux International, Inc.; Allen System, Inc.; Reef Industries, Inc. or approved equal.

### **Cable Marker**

Cable markers shall be as shown on the plans.

Cable markers shall be provided for FO conduits constructed in unpaved locations and placed at 50 feet spacing.

### **Communication Conduit Anchors**

Anchors used to attach communication conduits (electrical conduits) to the exterior surfaces of concrete structures and walls shall consist of metal straps and anchoring devices. Metal straps shall be made of steel and

shall be fabricated to the details and dimensions shown on the plans. Anchoring devices shall consist of mechanical expansion stud anchors. Anchors shall conform to the provisions in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

When communication conduits are installed vertically on a structure for a distance of 2 feet or more, but less than 10 feet, an anchor shall be installed at the top and bottom of the pipe within 0.5-foot of the elbows. Vertical distances of 10 feet or more shall have anchors installed at 10 feet on centers unless otherwise shown on the plans. Anchors used to support vertically installed pipe and conduit shall be installed as shown on the plans.

Holes for anchorage devices shall conform to the following:

- A. Reinforcing steel shall be located by nondestructive means before drilling holes for anchors. Holes shall not be drilled closer than 0.5-foot to the edge of a concrete structure.
- B. Holes shall be drilled with rotary drills. Impact drills shall not be used. Coring is not allowed.
- C. Holes shall be relocated if reinforcing steel is encountered. Abandoned holes shall be filled with portland cement concrete mortar conforming to the provisions in Section 51-1.135, "Mortar," of the Standard Specifications.
- D. Holes shall be drilled to a minimum depth of 8 times the diameter of the anchor bolt or stud anchor.
- E. Anchors shall be on Caltrans approved list for Mechanical Expansion Anchors and installed per recommendations by manufacturer:

[http://www.dot.ca.gov/hq/esc/approved\\_products\\_list/](http://www.dot.ca.gov/hq/esc/approved_products_list/)

### **Fiber Optic Pull Box**

Each fiber optic pull box shall conform to the requirements in Section 86-2.06, "Pull Boxes," of the Standard Specifications for Type 6 with extensions and as shown on the plans.

Conduits shall not protrude more than 2 inches inside the pull box and shall enter the pull box at about 20 degrees in both the vertical and horizontal directions.

### **Fiber Optic Vault**

Fiber optic vaults shall be 52" (L) x 34" (W) x 24" (D) nominal inside dimensions and shall conform to the requirements in Section 86-2.06, "Pull Boxes," of the Standard Specifications.

Vault cover shall be furnished and installed as either one or two elements, at the option of the Contractor.

Vault, cover and extensions may be constructed of reinforced portland cement concrete or of non-PCC material with concrete gray color.

Fiber optic vaults shall be installed as shown on the plans. All fiber optic vaults and covers shall have an AASHTO HS 20-44 rating. Fiber optic vaults shall be installed at grade. Metallic or non-metallic cable racks shall be installed on the interior of both long sides of the fiber optic vaults. The racks shall be capable of supporting a load of 100 pounds, minimum, per rack arm. Racks shall be supplied in lengths appropriate to the box in which they will be placed. All metallic cable racks shall be fabricated from ASTM A36 steel plate and shall be hot-dip galvanized after fabrication. Steel plate, hardware and galvanizing shall comply with the requirements in Section 75, "Miscellaneous Metal," of the Standard Specifications. Metallic cable racks shall be bonded and grounded.

Unless otherwise shown on the plans or directed by the Engineer, vault shall be installed outside of the pavement maintaining 5 feet distance from the cover centerline to the edge of the pavement or back of the dike. Vault may be installed farther from or closer to the roadway to accommodate buried objects, existing conduits, or similar items. Minimum distance from any part of the vault or backfill material to the edge of the pavement or back of the dike shall be 18 inches. The top of the vault cover shall be within  $1 \pm 0.5$  inch of adjacent finished grade.

When fiber optic vaults are installed in paved areas:

- 1. Distance from the centerline of the vault to the edge of pavement or back of dike shall not exceed 3 feet
- 2. Top of vault cover shall be  $0.1 \pm 0.05$  inch below of the adjacent pavement finished grade

Conduits shall not protrude more than 2 inches inside the vault and shall enter the vault at about 20 degrees in both the vertical and horizontal directions.



## **FIBER OPTIC AND FLEXIBLE FIBER OPTIC CABLES INSTALLATION**

Fiber optic cable and flexible fiber optic cable shall be installed in new or existing conduit-system as shown on the plans.

Installation shall be in conformance with the procedures specified by the cable manufacturer for the specific cable type. The Contractor shall submit to the Engineer the manufacturer's recommended procedures for pulling fiber optic cable at least 20 working days prior to installing cable. Mechanical aids may be used, provided that a tension measuring device is placed in tension to the end of the cable. The tension applied shall not exceed 500 pound-force or the manufacturers recommended pulling tension, whichever is less.

The cable shall be installed using a cable pulling lubricant recommended by the cable manufacture and a non-abrasive pull tape conforming to the provisions in Section 86-2.05C, "Installation," of Standard Specifications. The Contractor's personnel shall be stationed at each pull box, vault and cabinet through which the cable is pulled to lubricate and prevent kinking or other damage.

During cable installation, the bend radius shall be maintained at not less than twenty times the outside diameter of the cable. The cable grips for installing the fiber optic cable shall have a ball bearing swivel to prevent the cable from twisting during installation.

At the Contractor's option, the cable may be installed using compressed air to blow the cable into the conduit run. If integral innerduct is used, the duct splice points or any temporary splices of innerduct used for installation must withstand a static air pressure of 110 psi.

The fiber installation equipment shall include a mechanical drive unit or pusher, which feeds cable into the pressurized innerduct to provide a sufficient push force on the cable, which is coupled with the drag force created by the high-speed airflow.

The unit shall include controls to regulate the flow rate of compressed air entering the duct and any hydraulic or pneumatic pressure applied to the cable. It shall accommodate longitudinally ribbed or smooth wall ducts from nominal 0.625-inch to 2-inch inner diameter.

Mid assist or cascading of equipment shall be for the installation of long cable runs. The equipment shall incorporate safety shutoff valves to disable the system in the event of sudden changes in pneumatic or hydraulic pressure.

The equipment shall not require the use of a piston or any other air capturing device to impose a pulling force at the front end of the cable, which also significantly restricts the free flow of air through the innerduct. It shall incorporate the use of a counting device to determine the speed of the cable during installation and the length of the cable installed.

The cable shall be installed without splices except where specifically allowed on the plans or specified in these special provisions. Minimum slack of the cable as shown on the plans shall be provided at each cable access location without a cable splice. At fiber optic splice location, a minimum of 30 feet slack of each cable shall be stored in the splice location.

### **Fiber Optic Labeling**

#### **General**

The Contractor shall label all fiber optic cables with tags as specified in these special provisions. All tags placed along one cable shall contain the same cable identification code unique for that cable.

Tags shall be placed on the cables at the following points:

1. Fiber optic vault entrance and exit
2. Splice enclosures entrance and exit
3. FDU entrance

All tags shall be made of the same material designed for long term permanent labeling of fiber optic and copper communications cables. Metal tags shall be constructed of stainless steel. Material for non-metal tags shall be approved in writing by the Engineer.

Metal tags shall be marked with embossed lettering. Non-metal tags shall be marked with the permanent ink. Handwritten label markings shall not be allowed.

Labels shall be affixed to the cable per the manufacturer's recommendations in a manner that will not cause damage to the cable.

### Cable Identification Code

Cable identification code on a tag shall consists of the following groups:

| No. | DESCRIPTION                    | CODE   | NUMBER OF CHARACTERS |
|-----|--------------------------------|--|----------------------|
| 1   | Fiber Type                     | <b>S:</b> Singlemode   | 1                    |
| 2   | Fiber Count                    | <b>048 (example):</b> Actual number of fibers or conductor pairs   | 3                    |
| 3   | Begin Point                    | <b>T:</b> TMC<br><b>H:</b> Hub<br><b>V:</b> Video Node<br><b>D:</b> Data Node<br><b>C:</b> Cable Node<br><b>TV:</b> CCTV Camera<br><b>CM:</b> CMS<br><b>E:</b> Traffic Signal<br><b>RM:</b> Ramp Meter<br><b>TM:</b> Traffic Monitoring/ Count Station/Vehicle Count Station (VDS, TMS)<br><b>SV:</b> Splice Vault or Fiber Optic Vault<br><b>SC:</b> Splice Cabinet | 1 or 2               |
| 4   | Begin Point County Code Number | <b>35:</b> San Mateo<br><b>37:</b> Santa Clara   | 2                    |
| 5   | Begin Point Route Number       | One of the following: 082, 084, 101, 109, 114  | 3                    |
| 6   | Begin Point Post Mile          | <b>02470 (example):</b> Actual PM value  | 5                    |
| 7   | End Point                      | In the same manner as for Begin Point  | 1 or 2               |
| 8   | End Point County Code Number   | In the same manner as for Begin Point  | 2                    |
| 9   | End Point Route Number         | In the same manner as for Begin Point  | 3                    |
| 10  | End Point Post Mile            | In the same manner as for Begin Point  | 5                    |
| 11  | Cable ID number                | <b>03 (example):</b> Actual cable number in a vault or pull box  | 2                    |

### Determination of Begin and End Points

Begin point shall be associated with the lower numbered item in the following table. End point shall be associated with the higher numbered item. When both points are associated with the same item, begin point shall be associated with the lower equipment number.

|    |                                  |
|----|----------------------------------|
| 1  | TMC                              |
| 2  | HUB                              |
| 3  | Video Node (VN)                  |
| 4  | Data Node (DN)                   |
| 5  | Cable Node                       |
| 6  | CCTV Camera                      |
| 7  | CMS                              |
| 8  | Traffic Signal                   |
| 9  | Ramp Meter                       |
| 10 | Traffic Monitoring Count Station |
| 11 | HAR                              |
| 12 | EMS                              |
| 13 | Weather Station                  |
| 14 | Weight In Motion                 |
| 15 | Splice Vault or Cabinet          |

### **Begin and End Point Determination Examples**

A cable between:

1. HUB and TMC shall begin at TMC and end at HUB
2. Vault and CMS shall begin at CMS and end at Vault
3. HUB-03 and HUB-01 shall begin at HUB-01 and end at HUB-03

### **Cable Code Example**

The cable code S 048 SV 35 084 02470 SV 37 082 02510 03 shall be interpreted as a singlemode, 48 strand, cable starting at a fiber optic vault in San Mateo County on Route 84 at post mile 24.70, and ending at another fiber optic vault in Santa Clara County on Route 82 at postmile 25.10. Cable ID number indicates that the cable is the 3<sup>rd</sup> of the fiber optic cables in the vault.

### **Fiber Optic Cable Terminations**

#### **General**

Fiber optic cable shall be terminated with commercially available Fiber Distribution Unit (FDU). The FDU shall include:

1. Housing
2. Connector panels
3. ST Couplers
4. Splice trays
5. Fiber optic pigtails
6. ST connectors

All FDU components shall be produced by the same manufacturer.

Before procurement of FDU, the Contractor shall submit to the Engineer a Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificate of Compliance," of the Standard Specifications.

The cable shall be lashed with tie wraps to the rack prior to entering the FDU. The cable shall also be tie-wrapped to the inside of the FDU near the point of entry. The glass fibers shall not be damaged during cutting and removal of the buffer tubes.

The bare fibers shall be cleaned to remove the moisture blocking gel. The end of the remaining buffer tube shall be sealed to prevent future gel leak.

At each FDU, the Contractor shall provide a tabulated list of all terminated cables including:

1. Unique cable identification code
2. Location of each fiber on the connector panel

The list shall be placed in a waterproof pouch mounted on the cabinet door.

### **Housing**

The housing shall be rack-mountable type and shall have a maximum height of three rack-mounted units. The housing shall comply with ECA-310 standard.

The housing shall be able to accommodate sufficient number of connector panels and trays to handle the associated-fiber terminations.

The housing shall have a Lexan front cover protecting fiber optic connections from exposure. The front and back housing covers shall be retractable or removable to facilitate installation of splice trays.

### **Connector Panel**

Connector panel shall be installed in the front of the housing. Each side of the panel shall be secured to the housing frame with two plastic push snap fasteners.

Each panel shall have six coupler capacity. All panel positions shall be filled with couplers. All spare couplers shall have dust covers on both sides.

### **ST Coupler**

The ST coupler shall be made of either nickel-plated zinc or glass-reinforced polymer. Coupler mounting to the connector panel shall be flanged or threaded and shall fit the panel connector opening.

The operating temperature range for the coupler shall be as specified for the ST connector.

### **Splice Tray**

Splice tray shall be installed inside the housing. Each tray shall accommodate up to 12 fusion splices.

### **Fiber Optic Pigtail**

Pigtail shall consist of:

1. Simplex (one fiber) 900  $\mu$ m tight buffer
2. ST connector
3. Open end fiber prepared for fusion splice to field fiber

Buffer jacket shall be color coded in the same manner specified for fibers.

Pigtail minimum length shall be 3 feet.

### **ST Connector**

ST connector shall be ST "push-pull" type. Connector ferrule shall be made of zirconia ceramic and shall:

1. Be 2.5 mm diameter
2. Have a pre-radiused tip

Housing of indoor ST connector shall be made of either nickel-plated zinc or glass-reinforced polymer.

Housing of outdoor ST connector shall be glass-reinforced polymer.

The color of the housing or the boot shall be:

1. Yellow for singlemode connector
2. Orange for multimode connector

The ST connector operating temperature range shall be from -40 to +70 °C. Insertion loss shall not exceed 0.4 dB and the return reflection loss shall be at least 40 dB. Change of insertion loss shall not exceed 0.2 dB per 500 mating cycles when tested per TIA-455-21A (FOTP-21). All terminations shall provide a minimum 50 lbf pull-out strength. Factory test results shall be documented and submitted to the Engineer prior to installing any of the connectors.

### **Cable Splicing**

Field cable splices shall be done either in manholes or fiber optic vaults-or in cabinets as shown on the plans.

Unless otherwise indicated or approved by Engineer, the cable splices shall be fusion type. The mean splice loss shall not exceed 0.07 dB per splice. The mean splice loss shall be obtained by measuring the loss through the splice in both directions and then averaging the resultant values.

The mid-span access method shall be used to access the individual fibers in a cable for splicing to another cable as shown on the plans. Cable manufacturers recommended procedures and approved tools shall be used when performing a mid-span access. Only the fibers to be spliced may be cut. All measures shall be taken to avoid damaging buffer tubes and individual fibers including those not being used in the mid-span access.

The field splices shall connect the fibers of the two cable lengths together. These splices shall be placed in splice trays and these splice trays shall then be placed in the splice enclosure.

The termination splices shall connect the cable span ends with pigtails. The termination splices shall be placed in splice trays and the splice trays shall then be placed in the fiber distribution unit (FDU).

The individual fibers shall be looped at least one full turn within the splice tray to avoid micro bending. A 2 inches minimum bend radius shall be maintained during installation and after final assembly in the optical fiber splice tray. Each bare fiber shall be individually restrained in a splice tray. The optical fibers in buffer tubes and the placement of the bare optical fibers in the splice tray shall be such that there is no discernable tensile force on the optical fiber.

All splices shall be protected with a metal reinforced thermal shrink sleeve.

### **Fiber Optic Splice Enclosure**

Enclosure for fiber optic cable field splices shall be waterproof, rodent-proof and re-enterable. The enclosure shall be rated for a temperature range from 0 to 50 °C.

The fiber optic splice enclosure shall consist of an outer closure, an inner closure, complete with splice organizer trays, brackets, plugs, clips, cable ties and sealants as needed.

The size of the enclosure shall allow all the fibers of the largest fiber optic trunk cable or buffer tube to be spliced to a second cable or buffer tube of the same size, plus fibers from fiber optic pigtail cable. The enclosure shall not exceed 36 inches in length and 8 inches in diameter.

All materials in the enclosures shall be nonreactive and shall not support galvanic cell action. The outer closure shall be compatible with the other closure components, the inner closure, splice trays, and cables.

The end plate shall consist of two sections and shall have capacity for two fiber optic trunk cables and fiber optic branch cables.

The outer closure shall protect the splices from mechanical damage, shall provide strain relief for the cable, and shall be resistant to salt corrosion.

The outer closure shall be sealed with a gasket.

The inner closure shall be of metallic construction. The inner closure shall be compatible with the outer closure and the splice trays and shall allow access to and removal of individual splice trays. The splice trays shall be compatible with the inner closure and shall be constructed of rigid plastic or metal.

Adequate splice trays shall be provided to splice all fibers of the largest communication cable or buffer tube plus FPC.

Vinyl markers shall be used to identify each spliced fiber in the trays as specified under "Fiber Optic Cable Labeling" of these special provisions.

Each splice shall be individually mounted and mechanically protected in the splice tray.

The Contractor shall install the fiber splice enclosure in the manholes or fiber optic vaults as shown on the plans where splicing is required. The Contractor shall provide all mounting hardware required to securely mount the fiber optic splice enclosures.

The fiber splice enclosure shall be mounted as shown on the plans in a manner that allows the cables to enter at the end of the enclosure. At least 30 feet of each cable shall be coiled in the fiber optic vaults or manholes to allow the fiber splice enclosure to be removed for future splicing.

Fibers exposed for splicing within the enclosure shall be protected from mechanical damage using the fiber support tube or tubes and shall be secured within the fiber splice enclosure.

Upon completion of the splices, the splice trays shall be secured to the inner closure.

The enclosure shall be sealed using a procedure recommended by the manufacturer providing a waterproof environment for the splices. Encapsulant shall be injected between the inner and outer closures.

Care shall be taken at the cable entry points to ensure a tight waterproof seal is created. Multiple cables shall not enter the fiber splice enclosure through one cable entry point.

### **FLEXIBLE FIBER OPTIC TRANSMITTERS AND RECEIVERS**

Flexible fiber optic transmitters (FFOTS) connected to flexible fiber optic receivers (FFORS) via fiber optic link shall support a minimum optical loss budget of 13 dB over a pair of singlemode fibers. The data channels shall support 100Base-TX, 10Base-T Ethernet and IEEE 802.1Q protocols. The units shall be optimized for singlemode 8.3/125 μm fiber operating in the 1310 nm and 1510 nm optical windows. The optical connectors shall be of the ST-compatible type.

Each transmitter and receiver shall have status indicators in its front face panel for visual verification of bi-directional operation.

### **Performance Requirements**

FFOTS and FFORS shall meet the following performance requirements:

|                          |  |
|--------------------------|--|
| Data Channel             | 1 duplex                               |
| Data Format              | 100Base-TX Ethernet, 10Base-T Ethernet |
| Baud Rate                | Compliant with IEEE 802.3              |
| Optical Budget           | 13 dB                                  |
| Emitter Laser            | VCSEL                                  |
| Wavelength               | 1310 nm and 1550 nm                    |
| Transmitter Launch Power | -10 dBm                                |
| Receiver Sensitivity     | -23 dBm                                |
| Gain Control             | Optical Automatic                      |
| Input Power              | From 9 to 24 V(dc) regulated           |
| Current Requirement      | 300 mA                                 |
| Power Consumption        | Less than 10 W                         |
| Short Circuit Protection | Solid State                            |

### **Physical and Mechanical Requirements**

FFOTS and FFORS shall have the following interfaces:

1. Two ST singlemode fiber connectors.
2. One 8-position, 8-conductor modular data jack (RJ45).
3. One multiple screw terminal header power connector.

FFOTS and FFORS shall be housed in a compact stand-alone enclosure with side flanges and shall be shelf mountable. Enclosure outside dimensions shall not exceed 5" (W) x 3" (D) x 2" (H).

FFOTS and FFORS shall be powered by AC to DC wall mounted regulated power adapter rated:

1. Input - 120 V(ac), 60 Hz
2. Output - 9 to 24 V(dc) at minimum of 300 mA

### **Environmental Requirements**

FFOTS and FFORS shall be fully operational over a temperature range from -30 to +70 °C and shall withstand a humidity range from 0 to 95 percent without condensation.

### **FIBER OPTIC TESTING**

Fiber optic system components shall be tested:

1. At the factory
2. After delivery to the project site but prior to installation
3. After installation but prior to connection to any other portion of the system
4. During final system testing

The Contractor shall provide all personnel, equipment, instrumentation and materials necessary to perform all non factory testing. The Engineer shall be notified two working days prior to all field tests. The notification shall include the exact location of the system or components to be tested.

Documentation of all test results shall be provided to the Engineer within 5 working days after the test completion.

A minimum of 15 working days prior to arrival of the cable at the site, the Contractor shall provide detailed test procedures for all field testing for the Engineer's review and approval. The procedures shall include:

1. Test date and description
2. Test plan
3. Test equipment manufacturer and production date

4. Test equipment operating procedures

### **Factory Testing**

The Contractor shall submit to the Engineer the cable manufacturer's Certificate of Compliance with the Fiber Characteristics Tables of these special provisions. Before shipment, but while on the shipping reel, 100 percent of all fibers shall be tested for attenuation. Copies of test results shall be:

1. Maintained on file with a file identification number by the manufacturer for a minimum of seven years
2. Attached to the cable reel in a waterproof pouch
3. Submitted to the Contractor and to the Engineer

### **Testing at FO Cable and FFOC Delivery on Site**

The FO cable, FFOC and reels shall be physically inspected on delivery and 100 percent of the fibers shall be tested for compliance with attenuation requirements of these special provisions. Attenuation tests shall be performed with an OTDR capable of recording and displaying anomalies of 0.02 dB as a minimum. Singlemode fibers (SM) shall be tested at 1310 nm and at 1550 nm.

Site test results shall be recorded, dated, compared to and filed with the copy of factory test results accompanying the shipping reel. Attenuation deviations from the shipping records greater than 5 percent shall be brought to the attention of the Engineer.

If the test results are unsatisfactory, the reel of cable shall be considered unacceptable and all records corresponding to that reel of cable shall be marked accordingly. The unsatisfactory reels of cable shall be replaced with new reels of cable at the Contractor's expense. The new reels of cable shall be tested as specified above.

Copies of test results in graphic and tabular form shall be submitted to the Engineer for approval. The FO cable and FFOC shall not be installed until the Engineer approves test results in writing.

### **Testing After FO and FFOC Cable Installation**

After the cable has been pulled but before breakout and termination, 100 percent of all the fibers shall be tested with an OTDR for attenuation. Test results shall be recorded, dated, compared and filed with the previous copies of these tests. Copies of traces and test results shall be submitted to the Engineer. If the OTDR test results are unsatisfactory, the fiber optic cable segment is unacceptable. The unsatisfactory segment of cable shall be replaced with a new segment, without additional splices, at the Contractor's expense. The new segment of cable shall then be tested to demonstrate acceptability. Copies of the test results shall be submitted to the Engineer.

Attenuation tests shall be performed with an OTDR capable of recording and displaying anomalies of 0.02 dB as a minimum. Singlemode fibers (SM) shall be tested at 1310 nm and at 1550 nm. Attenuation readings shall be recorded on a cable data sheet showing factory and after installation results.

The OTDR shall have a printer capable of producing a verifying test trace with fiber identification as shown in Appendix A "Link Loss Budget Work Sheet," numerical loss values, the date and the operator's name. It shall also have recording capability that has associated software to do comparisons and reproductions on 8.5" x 11" paper, via a personal computer.

### **Fiber Optic System Gain Margin**

The installed system gain margin shall be at least 6 dB for each link. Test results shall be recorded and submitted to the Engineer for approval.

If the design system gain margin is less than 6 dB, the Contractor shall notify the Engineer and perform corrective measures to meet the requirement.

Cable link at each termination shall be tested for insertion attenuation loss with the use of an optical power meter and source. In addition, all singlemode terminations shall be tested for return reflection loss. These values shall meet the loss requirements specified in these special provisions.

The final test results shall be recorded, along with previous individual component values, on a special form assigned to each FDU. The completed form shall be dated and signed by the Contractor. One copy of this form in a plastic envelope shall be attached to the assembled FDU unit. Five copies shall be submitted provided to the Engineer.

### **FFOTS and FFORS Component Testing**

The transmitters and receivers shall be tested with a power meter and light source, to record the transmitter average output power in (dBm) and receiver sensitivity in (dBm). These values shall be recorded in the "Link Loss Budget Work Sheet" shown in Appendix A.

### **System Verification at Completion**

Once fiber optic system has been installed and is ready for activation, 100 percent of the fiber links shall be tested with the OTDR for attenuation at both wavelengths. Test results shall be recorded, dated, compared to and filed with previous copies. A hard copy printout and an electronic copy of the traces and test results, along with a licensed copy of the software used to create the test traces on a 16 GB or larger USB version 2.0 flash drive or a Secure Digital card, shall be submitted to the Engineer. If the OTDR test results are unsatisfactory the link shall be replaced at the Contractor's expense. The new link shall then be tested to demonstrate acceptability. Copies of the test results shall be submitted to the Engineer.

The "Link Loss Budget Work Sheet" shown in Appendix A shall be completed for each link in the fiber optic system, using the data gathered throughout the installation process. The completed work sheets shall be included as part of the system documentation in the As-Built Plans.

The "Total System Gain" shall be calculated by subtracting the measured "Optical Receiver Sensitivity" (line 1B on the "Link Loss Budget Work Sheet") from the measured "Optical Transmitter Average Power" (line 1A), which was obtained using a power meter and source. The resulting difference shall be the maximum allowable loss between the transmitter and the receiver, within 0 to +10 percent of the manufacturers specified loss budget for the transmitter/receiver pair. The "Total System Gain" shall be recorded on line 1C.

The "Fiber Losses" for a link shall be calculated by multiplying the length of the fiber link (line 2A) by the normalized cable attenuation (dB/km, line 2B) at the operating wavelength. The normalized attenuation for this calculation shall be the maximum value throughout the operating temperature range of the cable. The product shall be recorded on line 2C.

The total connector losses shall be calculated by summing the individual attenuation values for each connector pair in the link, excluding the transmitter and receiver connectors. The sum shall be recorded on line 2D.

The total splice losses shall be calculated by summing the individual attenuation values for each splice in the link. The sum shall be recorded on line 2E.

The total of other losses shall be calculated by summing the individual attenuation values for each component in the link not previously addressed. The sum shall be recorded on line 2F. These items may include, couplers, splitters, routers and switches.

The "Total System Loss" shall be recorded on line 2G of the "Link Loss Budget Work Sheet."

The "Design System Gain Margin" shall be calculated by subtracting the Total System Loss (line 2G) from the Total System Gain (line 1C). The resulting difference shall be recorded on line 3A. The Contractor shall comply with "FO System Gain Margin," of these special provisions.

At the conclusion of the final OTDR testing, 100 percent of all fiber links shall be tested end to end with a power meter and light source, in accordance with EIA Optical Test Procedure 171 and in the same wavelengths specified for the OTDR tests. These tests shall be conducted in both directions. Test results shall be recorded, compared and proven to be within the design link loss budgets, and filed with the other recordings of the same links. Test results shall be submitted to the Engineer.

If during any of these system verification tests, the results prove to be unsatisfactory, the FO cable shall not be accepted. The unsatisfactory segments of cable shall be replaced with a new segment of cable at the Contractor's expense. The new segment of cable shall undergo the same testing procedure to determine acceptability. Copies of the test results shall be submitted to the Engineer. The removal and replacement of a segment of cable shall include a single contiguous length of cable connecting two splices, two connectors, or a splice and a connector.



## APPENDIX A

### Link Loss Budget Work Sheet

Contract No. \_\_\_\_\_

Contractor: \_\_\_\_\_

Approved by Caltrans: \_\_\_\_\_

Date: \_\_\_\_\_

Operator: \_\_\_\_\_

Link Number: \_\_\_\_\_

Fiber Color: \_\_\_\_\_

Buffer Color: \_\_\_\_\_

Cable #: \_\_\_\_\_

Test Wavelength (Circle one):      1310 nm      1550 nm

#### Section 1: Total System Gain

Measured Optical Transmitter Average Power: \_\_\_\_\_ dBm      1A

Measured Optical Receiver Sensitivity  
(this should be a negative value): \_\_\_\_\_ dBm      1B

Subtract line 1B from 1A to obtain Total System  
Gain: \_\_\_\_\_ dB      1C

#### Section 2: Total System Loss

Measured length of the link: \_\_\_\_\_ km      2A

Measured loss per km of the fiber: \_\_\_\_\_ dB/km      2B

Multiply line 2A by 2B to obtain the Total Fiber  
Loss: \_\_\_\_\_ dB      2C

Sum of all Connector Losses in the link: \_\_\_\_\_ dB      2D

Sum of all Splice Losses in the link: \_\_\_\_\_ dB      2E

Sum of all Other Losses from other components  
(couplers, splitters, routers, switches, etc.) \_\_\_\_\_ dB      2F

Add lines 2C, 2D, 2E and 2F to obtain Total System  
Loss: \_\_\_\_\_ dB      2G

#### Section 3: Design System Gain Margin

Subtract line 2G from line 1C

(This number must be at least 6 dB): \_\_\_\_\_ dB      3A

## **10-3.19 ARTERIAL DYNAMIC MESSAGE SIGN PANEL AND ASSEMBLY**

### **GENERAL**

#### **Summary**

This work includes installing Arterial Dynamic Message Sign (ADMS) Panel and Assembly (ADMSPS) as shown on the plans and as specified in these special provisions.

ADMSPS shall consist of:

1. ADMS sign panel
2. ADMS controller assembly
3. ADMS controller cabinet
4. ADMS sign interface cable

#### **Submittals**

If any changes to the approved shop drawings were made during ADMSPS fabrication, the Contractor shall submit to the Engineer three updated sets of shop drawings at least 30 days prior to ADMSPS installation.

Before ADMSPS is shipped to the site, the Contractor shall submit to the Engineer:

1. Two copies of the ADMSPS manuals
2. Documentation for quality assurance inspection, functional testing and acceptance testing performed by the manufacturer

#### **Warranty**

Before ADMSPS installation, the Contractor shall submit to the Engineer a written manufacturer's warranty against defects in materials and workmanship.

The manufacturer shall replace or repair any sign panel or sign controller that failed due to workmanship or material defects within 48 months of the successful completion of ADMSPS.

Replacement shall be provided at no cost to the State within 15 days after receipt of failed parts. Replacement parts shall be delivered to State Maintenance Electrical Shop at Caltrans Maintenance Station, 30 Rickard Street, San Francisco, CA 94134.

### **MATERIALS**

#### **ADMS Sign Panel**

The ADMS sign panel shall be one of the following or approved equal:

1. Skyline VMSLED-L-08F-28x050-I
2. Daktronics VL-3500-24x64-34A
3. Imago BRICK DMS AF0-2H2A0-0602V

#### **ADMS Controller Assembly**

##### **General**

ADMS controller assembly shall be compatible and approved for use with the sign panel by ADMS panel manufacturer.

ADMS controller assembly shall consist of:

1. Sign controller
2. Power supply and cables
3. Sign Operating Software

Operating temperature shall be from -20 to +60 °C.

##### **Sign Controller**

Sign Controller shall include:

1. Communication interface for remote communications
2. Firmware

3. Dimming control

### **Communication Interface**

Communication interface shall include:

1. Configuration port supporting TIA-232 through DE9 connector
2. Network communications port supporting Ethernet 10/100 Mbps through 8P8C modular connector

### **Firmware**

Firmware shall allow creating, editing and saving a minimum of 50 messages and 99 pages. These shall be stored in non-volatile memory and shall remain unaltered for a minimum of 30 days without AC power to the sign controller.

The firmware shall interact with the sign panel through a menu-driven interface. The firmware shall be accessible via either the keyboard or the TIA-232 port.

Access to the firmware shall be protected by multi-level password control.

The firmware shall be NTCIP (National Transportation Communication for ITS Protocol) compliant, including the following standards:

1. NTCIP 1203, v02.39b "Object Definitions for Dynamic Message Signs" including normative references
2. NTCIP 1101 "Simple Transportation Management Framework"
3. NTCIP 2103 "Point to Point Protocol over RS-232 Subnetwork Profile"
4. NTCIP 2201 "Transportation Transport Profile"

The firmware shall support the following Tags specified in NTCIP 1203, v02.39b:

1. Flash
2. Font
3. Graphic
4. Justification - Line
5. Justification - Page
6. New Line
7. New Page
8. Page Time
9. Spacing Character

### **Dimming Control**

The sign controller shall automatically adjust the intensity of all pixels by means of photo sensors installed in the sign housing. There shall be a minimum of three adjustable levels of luminance: 100 percent, 60 percent, and 30 percent luminance.

A single-throw "Dim Test" switch shall be provided to override the automatic intensity selection and force each activated pixel to 30 percent luminance.

### **Sign Operating Software**

The sign operating software (SOS) shall enable a PC laptop to interact with sign controller via an on-board communications interface. This port may be either Ethernet or TIA-232.

The manufacturer shall furnish one copy of the SOS in CD-ROM format for each ADMSPS delivered in the contract.

### **ADMS Controller Cabinet**

ADMS Controller Cabinet shall be Telephone Demarcation Cabinet Type B and shall conform to the details shown on the plans.

Manufacturer's name and trademark shall be permanently marked inside the cabinet. Model, serial number and shipping date shall be stamped on a tag that shall be affixed inside the cabinet. The lettering shall have a minimum height of 9/32 inch. The lettering may be either depressed or raised, and shall be legible and durable.

### **ADMS Sign Interface Cable**

The sign interface cable shall connect the sign panel to sign controller assembly and shall be continuous without splicing. The cable shall be approved for use by the sign manufacturer. The manufacturer identification shall be printed in white ink every foot along the surface of the cable. The cable shall meet all specifications for outdoor use. The cable length shall be a minimum of 50 feet.

## **CONSTRUCTION**

### **Installation**

The ADMSPS shall be installed as shown on the plans and as directed by the Engineer.

The Contractor shall configure the sign controller assembly to make ADMSPS operational and ready to accept communications. The Contractor shall provide to the Engineer documentation detailing the configuration of each ADMSPS.

### **Testing**

After installation at the site, a minimum of 5 different messages composed of text and graphics shall be displayed. Any others tests recommended by the manufacturer shall also be conducted. Each ADMSPS shall conform to requirements specified in "System Testing and Documentation" elsewhere in these special provisions.

## **10-3.20 SIGNAL INTERCONNECT NETWORK ELEMENT**

### **GENERAL**

#### **Summary**

This work includes installing a Signal Interconnect Network Element (SINE) as shown on the plans and as specified in these special provisions.

#### **Submittals**

Before procurement of SINE equipment, the Contractor shall submit to the Engineer a Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificate of Compliance," of the Standard Specifications.

#### **Functional Requirements**

SINE shall operate with other SINEs over Signal Interconnect Cable (SIC) to extend or bridge field Ethernet networks for Intelligent Transportation Systems (ITS) and traffic signal systems. SINE shall be interoperable with industry standard Ethernet network capable equipment and rated for use in outdoor enclosures without the use of mechanical cooling. Operations of SINE shall be transparent to end users and other industry standard Ethernet network capable equipment.

#### **Warranty**

The Contractor shall provide the manufacturer's written warranty against defects in materials and workmanship of SINE units for a period of 24 months after installation of the SINE units. Replacement of a SINE unit shall be provided within 15 days after receipt of failed units at no cost to the State, except the cost of shipping the failed SINE unit. All warranty documentation shall be given to the Engineer prior to installation. Replacement units shall be delivered to Caltrans-District 4, 111 Grand Ave, Oakland, CA 94612.

## **MATERIALS**

### **General**

The Contractor shall provide all necessary mounting hardware, power supplies, cables, and connectors required for installation of a SINE. SINE shall be rated for outdoor enclosure installation. All wiring and cabling shall be as specified in Transportation Electrical Equipment Specifications (TEES) Section 1.3.13, "Wiring / Cabling / Harnesses."

### **SINE Minimum Requirements**

The SINE shall meet the following minimum requirements:

|  |  |
|--|--|
| LED Indicators                                       | Power, Activity, Link Status, Alarm  |
| Maximum Dimensions                                   | 3.4" (2U) x 10" x 12" (Height x Width x Depth)   |
| Mounting   | Rackmount Adapter, Shelf, Wall Capable   |
| Operating Temperature                                | From -10 to 60 °C  |
| Operating Humidity                                   | From 10 to 90 percent (Non condensing)   |
| Power  | Either 120 V(ac) or from 6 to 24 V(dc)   |
| Maximum Power Consumption                            | 75 W   |
| Power Connection                                     | Either 120 V(ac): 3 prong cord, at least 3 feet in length or from 6 to 24 V(dc): Terminal block and 120 V(ac) DC Class 2 transformer with 3 prong cord, at least 4 feet in length  |
| Maximum Weight                                       | 5 pounds without mounting hardware   |
| Grounding  | Required   |
| Operational Uptime                                   | 99.5 percent measured over a 30-day period, excluding maintenance  |
| Certifications and Regulations                       | FCC Part 15 Class B, UL 60950  |
| Minimum Number of Supported SIC Pairs per Modem Port | 4  |
| Minimum Number of Modem Ports                        | 1  |
| Supported Network Architecture                       | Point to point, Linear Add-Drop (Daisy Chain)  |
| Minimum Supported Add-Drop Locations                 | 6  |
| Communication Protocol                               | IEEE 802.3ah 2Base-TL  |
| Line Coding  | G.SHDSL.bis line   |
| Minimum Line Rate per SIC pair                       | 10 Mb/s symmetrical at 1000 meters (Ideal)   |
| Minimum Total Bandwidth with Bonded SIC Pairs        | 40 Mb/s at 1000 meters (Ideal)   |
| Bonding Standard                                     | EFM/G bond   |
| Modem Port Connector                                 | RJ 45 or Terminal Block  |
| Maximum End to End Delay between SINE                | 6 ms   |
| MES Port Type  | Autosensing 10/100BaseT, Full Duplex/Half Duplex   |
| Minimum Number of MES Ports                          | 4  |
| MES Port Connector                                   | RJ45   |
| Supported Standards                                  | Dynamic Bridging: IEEE 802.1<br>Discovery Mechanisms: LLDP<br>VLAN Tagging: IEEE 802.1Q<br>Double Tagging: Q-in-Q RSTP<br>STP IEEE: 802.1d<br>Link Aggregation: IEEE 802.3ad<br>Provider Bridges: IEEE 802.1ad<br>OAM: IEEE 802.3ah clause 57<br>Connectivity Fault Management: IEEE 802.1ag<br>Class of Service (CoS) 802.1p<br>Ethernet: IEEE 802.3i<br>Fast Ethernet: IEEE 802.3u<br>TCP/IP, UDP/IP |
| Supported Management Protocols                       | SNMP: SNMP v1, SNMP v2c<br>Command Line Interface: TL1<br>Remote Access: Telnet<br>Time Synchronization: SNTP v3<br>Web Access: HTTP<br>File Transfer: FTP   |
| Local Management Port                                | TIA-232 via DE9  |
| Remote Management Software                           | Web Browser or Microsoft Windows 2000 or newer Application   |

### **Integrated Modules**

Each SINE shall consist of the following integrated modules:

1. Digital Subscriber Line (DSL) Modem
2. Managed Ethernet Switch (MES)
3. Network Management System (NMS)

#### **Digital Subscriber Line Modem**

The DSL modem shall manage the Ethernet network link over SIC between SINE units. DSL modem shall be capable of bonding multiple pairs of SIC together to increase link bandwidth and splitting SIC pairs in 2 directions supporting linear add-drop networking. DSL modem operation shall be transparent. If an individual SIC copper pair fails, the network link shall remain in operation with proportionally lesser-bonded bandwidth without any user intervention.

#### **Managed Ethernet Switch**

The MES shall provide Ethernet network access to multiple Ethernet network capable devices.

#### **Network Management System**

The NMS shall provide the operator the capability to locally or remotely configure and maintain the SINE. The NMS shall allow authorized users the ability to monitor SINE functions, performance and unit faults at any time. The NMS shall be password protected.

### **Components**

Each SINE unit shall be furnished and configured with the following components:

1. Rackmount Adapter
2. Cables
3. Punchdown Block
4. Rack-mount Power Strip

#### **Rackmount Adapter**

The rackmount adapter shall provide a mounting location for the SINE. The rackmount adapter shall be no more than 2U in height and compatible with Model 332 Cabinet ECA-19 inch rack cages.

#### **Cables**

The Contractor shall furnish the following cables as shown on the plans with appropriate connectors:

- 1 Twisted Wire Pair (TWP) - 300 V rated, twisted pair copper, No. 22-24 AWG, Category 5e compliant(ANSI/TIA 568), factory made
2. Network Straight Through Data Cable (See "Interface Cables")
3. Ground - No. 16 Min AWG solid conductor
4. Jumper - No. 22-24 AWG insulated solid copper conductor

#### **Punchdown Block**

The punchdown block shall provide a termination point for breakout of TWP and jumper cables as shown on the plans.

The punchdown block shall meet the following requirements:

|                            |  |
|----------------------------|--|
| Punchdown Block Type       | Straight-thru (Pass-thru)                          |
| Termination Type           | 110 Style  |
| Supported Conductors       | No 22-24 AWG                                       |
| Minimum Conductor Capacity | 4-pair (8 conductors) in each direction            |
| Mounting Options           | Wall mount on Type 332 Cabinet Service Panel No. 1 |
| Maximum Dimensions         | 6" x 6" x 2" (Height x Width x Depth)              |

### **Rack-mount Power Strip**

Each rackmount power strip shall meet the requirements specified in "Camera Station" of these special provisions.

## **CONSTRUCTION**

### **Installation**

The Contractor shall perform site analysis. The site analysis shall, at a minimum, indicate the potential maximum line rate per SIC pair between connected SINE and any performance and uptime altering abnormalities in the existing SIC. In the event the existing SIC is found to be unusable or unable to support 25 percent of the minimum line rate per SIC pair, the Engineer may choose to use an alternate SIC routing. The Engineer, with concurrence from District Signal Operations Branch, will make final determination of all SIC to be connected to SINE.

The Contractor shall provide at least 14 days written notice to the Engineer before beginning installation of the SINE. The Contractor shall securely mount the rack-mount adapter and rack-mount power strip inside existing Model 332 cabinets. The Contractor shall install the SINE inside the rackmount adapter, and make all wiring connections as shown on the plans and as directed by the Engineer. If existing Model 332 cabinets contain equipment prohibiting the installation of the rackmount adapter, the option of wall or shelf mounting is allowed per Engineer's approval.

The Contractor shall configure the SINE under the supervision of the manufacturer's representative. Configuration shall include programming of all parameters to make the SINE operational and capable of transmitting and receiving data. The Engineer will provide the network addresses and related parameters to the Contractor. The Contractor shall provide one set of documents detailing the parameters configured and SINE related wiring per SINE installed.

### **Testing**

The Contractor shall conduct performance testing and provide the report to the Engineer for approval. The Contractor shall provide a test plan indicating proposed dates, duration and methods of the testing. The Contractor shall collect and submit the data to be certified by the Engineer. If required by the Engineer, the data shall be collected in the presence of the Engineer. Each SINE shall be shown to be able to:

1. Sustain data transfer between connected SINE at the line rate per SIC pair as indicated in the initial site analysis.
2. Operate without any unit, power and communication faults or alarms for 14 consecutive days. Faults and alarms shall be explained to the Engineer.
3. Conform to the requirements specified in the "System Testing and Documentation" of these special provisions.

The Engineer will review the accuracy data findings and accept or reject the results within 21 days.

### **Training**

The Contractor shall provide a minimum of 4 hours of training by a certified manufacturer's representative for up to 10 State employees selected by the Engineer. The content of the training shall include instructions on how to configure and maintain a SINE. The Contractor shall provide materials and equipment for the training, including one set of user manuals per person. The Contractor shall give the Engineer 15 days written notice prior to the training. The Engineer and the Contractor shall mutually agree on the date and time of the training. A training area will be provided by the State at the Caltrans District 4 Office at 111 Grand Ave., Oakland, CA 94612.

## **10-3.21 MICROWAVE VEHICLE DETECTION SYSTEM**

### **GENERAL**

#### **Summary**

This work includes installing a microwave vehicle detection system (MVDS) as shown on the plans and as specified in these special provisions.

MVDS shall consist of:

1. MVDS sensor unit
2. Photovoltaic (PV) power supply
3. Serial radio system (SRS)

4. MVDS pole and foundation as specified in "Standards, Steel Pedestals, and Posts" and "Cast-in-Drilled Hole Concrete Pile Foundations," of these special provisions.

### **Submittals**

#### **Materials List and Drawings**

A list of materials which the Contractor proposes to install for the MVDS together with the drawings and other data shall be submitted to the Engineer in conformance with Section 86-1.04, "Equipment List and Drawings," of the Standard Specifications. Additionally, the following shall be provided before the completion of the contract:

1. **Certificate of Compliance** - A Certificate of Compliance for MVDS shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.
2. **Site Analysis Report** - Prior to MVDS installation, the Contractor shall review each detection site and provide a written analysis recommending the optimum sensor placement for meeting the performance requirements of this special provision. The analysis shall be reviewed and approved by the MVDS Manufacturer.
3. **Lane Configuration** - The documentation shall include a diagram that illustrates how the microwave beam is covering the traffic lanes as well as the corresponding MVDS connector pins or wire terminals that correspond to the respective lanes. The lanes shall be identified by direction (NB, SB, EB, WB), and in order, with lane one being the lane nearest to the center of the roadway.
4. **Mounting and Wiring Information** - The Contractor shall provide to the Engineer for approval one set of detailed diagrams showing wiring connections for each MVDS. The approved diagrams shall be covered separately on each side with clear self-adhesive plastic and placed in a heavy-duty plastic envelope. The envelope shall be attached securely to the inside of the cabinet door or at a location designated by the Engineer.
5. **Communication Protocol** - The MVDS communication protocol shall be open and shall be freely available for use in the public domain. The Contractor shall provide documentation that defines the complete MVDS communication protocol (e.g. message structure organization, data packet length, as well as all information necessary to make use of such messages).
6. **Remote Programming** - The Contractor shall provide all information and software necessary for operating the system from a remote Windows 2000/NT or newer based Personal Computer (PC). This information and software shall include at minimum the capability to calibrate, tune, align, and program the MVDS and shall be provided on a Windows 2000/NT or newer compatible compact disc (CD). The information shall be formatted so that the files can be matched with the equipment being calibrated or aligned. This documentation shall contain files that allow for replacement equipment to be loaded with the same configuration.
7. **MVDS Accuracy Analysis** - The Contractor shall conduct MVDS Performance Testing and shall submit to the Engineer an MVDS accuracy analysis that conforms to requirements of these special provisions within 15 days of MVDS testing. The video recordings as well as digital versatile disc (DVD) or CD copies of the video images covering the analysis periods shall be included.
8. **Acceptance Testing Documentation** - The Contractor shall provide a test plan, containing time and period of the testing, to be approved by the Engineer. The test plan shall be organized so that the Engineer will be able to perform acceptance testing using the documentation without assistance from the Contractor. The Contractor shall collect and submit the data to be certified by the Engineer. If required by the Engineer, the data shall be collected in the presence of the Engineer.
9. **Acceptance Testing Schedule** - The Contractor shall submit a testing schedule for the preliminary functional test and the final location acceptance test to the Engineer for approval 15 days prior to acceptance testing of the MVDS installation. If the testing period extends beyond the normal working shift or if the Contractor fails to provide the necessary material for the testing within one hour of the scheduled testing start time, the Engineer may cancel testing for the day.
10. **Training** - The Contractor shall provide a copy of the training material to the Engineer for approval 30 days prior to the training. The content of the training shall include instruction on how to align, program, adjust, calibrate and maintain the MVDS.

### **Warranty**

The Contractor shall submit to the Engineer a written warranty from the SRS and PV power supply manufacturer or vendor against defects in materials and workmanship for all equipment for a minimum period of 24 months after project completion. PV panels shall carry a 20 year warranty.



## Functional Requirements

MVDSs shall simultaneously provide vehicle detection data in the form of vehicle volumes, counts, speed, classification, and occupancy with the performance requirements of these special provisions. MVDS shall provide a separate zone per lane. MVDS shall monitor traffic lanes in the presence of barrier railings, guardrails and other obstacles.

MVDS shall meet the following detection performance criteria:

1. Average 5 minute volumes for all lanes combined with better than 95 percent accuracy compared to vehicles observed in video images for the same period, for any 15 minute period selected by the Engineer.
2. Average 30 second volumes in every lane with better than 90 percent accuracy compared to vehicles observed in video images for the same period, for any 5 minute period selected by the Engineer.
3. Average 30 second speed in any lane with better than 95 percent accuracy, for any 5 minute period selected by the Engineer.
4. Average 5 minute occupancy for any lane with better than 85 percent accuracy, for any 15 minute period selected by the Engineer.
5. Count accuracy, when compared to vehicles observed in video images for the same period, shall be not less than 90 percent for any lane and not less than 95 percent for all lanes combined.
6. Average 15minute classification according to user defined criteria with better than 90 percent accuracy compared to vehicles observed in video images for the same period. Vehicle classification (or length classification) shall be provided for categories (small car, average car, mid size car, long car, extra-long car) that are user definable as either by length parameters (minimum length to maximum length for the category) or by a multiple of length of the average car.
7. The Contractor shall provide the criteria for speed and volume acceptance test for approval by the Engineer. The Contractor shall also provide speed and volume data for verification by the Engineer.

## MATERIALS

### MVDS Sensor Unit

The MVDS sensor unit shall be RTMS G4 as manufactured by Econolite Group Inc., 1933 Davis Street Suite 305, San Leandro, CA 94577, telephone (416) 409-0777. Arrangements have been made to ensure that any successful bidder can obtain the MVDS sensor unit and training class for State employees from the manufacturer.

The price quoted by the manufacturer for each component is:

| Product Details   | Unit Price               |
|---|--------------------------|
| RTMS G4 with internal 900 MHz radio link, whip antenna, mounting bracket, 40 foot cable for power for TIA232/TIA485 communication, on-site technical assistance | \$5,480                  |
| Training class, including training materials and equipment, as specified in these special provisions  | \$2,500<br>(per session) |

The above prices do not include tax and freight. The above prices are firm for orders placed before April 30, 2013.

### Serial Radio System

The serial radio system (SRS) shall consist of:

1. MVDS radio
2. MVDS radio antenna
3. Serial Ethernet converter
4. Control software
5. Equipment shelf with brackets as specified in "Camera Station" of these special provisions
6. Mounting hardware, power supplies, surge suppression cables, connectors and wiring

### MVDS Radio

The MVDS radio shall be as shown on the plans and as specified in these special provisions. The Contractor shall verify the mounting location with the Engineer and provide all required cabling. The frequency-hopping spread spectrum (FHSS) radio shall be compatible with the MVDS sensor unit and wirelessly transmit data between

the MVDS sensor unit and a SINE or Edge Ethernet Switch. MVDS sensor unit data shall be accessible at the San Mateo hub at the completion of all work as specified in these special provisions.

MVDS radio shall meet the following requirements:

|                              |   |
|------------------------------|---|
| Technology                   | Frequency Hopping Spread Spectrum (FHSS)                              |
| Frequency Range              | From 902 to 928 MHz   |
| Output Power                 | 1 mW, 10 mW, 100 mW, 1 W (User Selectable)                            |
| Receiver Sensitivity         | -103 dBm (at 76.8 kbps)   |
| Available Hopping Sequences: | 64 with selectable hop band   |
| Error Detection / Correction | 16 bit CRC with Auto Re-Transmit                                      |
| Operation                    | Point-to-Multipoint   |
| Input Power                  | From 3.0 to 3.8 V(dc) {3.3 V(dc) typical}                             |
| Power Consumption            | 900 mA at 1 W transmit, 22 mA at receive                              |
| Sleep Mode                   | 0.05 mA typical   |
| Security                     | Network ID, unit address, 16-bit encryption key, proprietary protocol |
| Operating Environment        | From -10 to +158 °F   |
| Humidity                     | From 5 to 95 percent, non-condensing                                  |
| Data Rate                    | From 1200 bps to 115.2 kbps   |
| Data Format                  | 8/9 bits  |
| Data Latency                 | 10 ms typical   |
| Maximum Physical Size        | 6" ( L) x 6" (W) x 2" (H)   |
| Main Connector               | 12 pins – 0.1in pitch header or DB9F                                  |
| Antenna Connector            | MCX Jack or SMA   |
| Certification                | FCC PLQENC900   |
| Configuration Port           | DE9-F   |
| Data rate in RF Channel      | 172.8 kbps  |
| Indicators                   | TX Data, RX Data, PWR   |
| RSSI LEDs                    | 3 in stepped scale  |
| Certifications               | FCC Part 15 and UL 60950-1  |

#### **MVDS Radio Antenna**

The MVDS radio antenna shall be compatible with the MVDS radio and include antenna cable to connect to the MVDS radio. The MVDS radio antenna shall be low profile, weatherproof, and shall be flush-mounted on the top of a Model 332 cabinet. Antenna shall not require more than one thru bore hole on the top of a Model 332 cabinet.

The MVDS radio antenna shall meet the following requirements:

|                 |                        |
|-----------------|------------------------|
| Frequency Range | From 902 to 928 MHz    |
| Gain            | +3 dBi                 |
| Power           | 100 W                  |
| Polarization    | Vertical               |
| Impedance       | 50 Ω                   |
| Azimuth         | Omnidirectional        |
| Elevation       | Cosine Shaped Monopole |
| Environmental   | From -10 to +158 °F    |

### **Serial Ethernet Converter**

The serial Ethernet converter shall provide an interface between the MVDS radio and the edge Ethernet switch or SINE. The Contractor shall furnish all appropriate cables and Microsoft Windows based configuration software and configure the serial Ethernet converter. The operation of the serial Ethernet converter shall be transparent and meet the following requirements:

|                          |   |
|--------------------------|---|
| Number of Ethernet Ports | One 8P8C per TIA-568  |
| Number of Serial Ports   | One DE9M  |
| Serial Port Interface    | TIA-232, 422 or 485   |
| Serial Port Speeds       | From 300 bps to 230 kbps  |
| Serial Port Data Bits    | 5,6,7,8, 9-bit protocol support   |
| Serial Port Parity       | Odd, even, mark, space, none  |
| Serial Port Flow Control | Hardware, software, both  |
| Serial Port Protection   | 15 kV Electrostatic Discharge Protection ( ESD )                                |
| Local Console Port       | TIA-232 on Serial Port  |
| Network Port Interface   | Auto sensing 10-base T / 100-base TX, software selectable Half/Full/Auto duplex |
| Network Protocols        | TCP/IP, UDP/IP, ARP, ICMP, SNMP, TFTP, Telnet, DHCP, BOOTP, HTTP                |
| Local Console Port       | TIA-232 on Serial Port  |
| Power Supply             | 120 V(ac) UL listed Class 2 power adapter, type B plug                          |
| Humidity                 | From 10 to 95 percent (non condensing)  |
| Operating Temperature    | From -10 to +158 °F   |
| Maximum Dimensions       | 5" x 5" x 2" (W x L x H)  |
| Mounting Options         | Din rail, wall mount or shelf mount   |
| Certifications           | FCC Part 15, Subpart B and UL 60950-1   |

### **Control Software**

The control software shall have features to provide for remote programming, remote maintenance, site diagnostics (signal strength) and system diagnostics (data testing, link integrity). Software shall operate in Windows XP or later platforms. Software shall provide system-wide diagnostics capabilities directly from the access point.

### **Photovoltaic Power Supply**

#### **General**

Photovoltaic (PV) power supply shall consist of:

1. Panel support structure
2. PV panels and batteries in quantities shown on the plans
3. Load/charge controller
4. NEMA 3R enclosure

Components of PV power supply shall be designed for outdoor use and approved by the Underwriters Laboratory.

Each PV power supply shall provide 12 V(dc) to the system 24 hours per day and shall be capable of operating four days without additional charge from the PV panels. A load/charge controller shall charge the batteries during daytime while providing 12 V(dc) to the system 24 hours per day. The PV power supply shall be designed to operate in ambient air temperatures from -10 to +149 °F.

#### **Panel Support Structure**

The panel support structure shall hold the PV panels securely on the pole at the angle shown on the plans. The PV panels shall be oriented directly south to maximize the collection of solar energy. The panel support structure

shall withstand 100 mph basic wind speed (3 second gust) per AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals dated 2001.

### **Photovoltaic Panels**

Each photovoltaic (PV) panel shall meet the following requirements:

| Parameter                   | Minimum Requirements              |
|-----------------------------|-----------------------------------|
| Peak Power Output *         | 100 +10 percent /- 5 percent W**  |
| Voltage at Maximum Power    | 17.4 V(dc) **                     |
| Current at Maximum Power    | 5.0 A **                          |
| Weight                      | 31.0 pounds or less**             |
| Dimensions                  | As shown on the plans             |
| Hailstone Impact Resistance | 1" diameter at 50 mph             |
| Operating Temperature Range | From 10 to +149 °F, minimum range |
| Salt Mist Corrosion         | IEC 61701:1995                    |

\*Standard test conditions identified as: Irradiance = 93 W/square foot, cell temperature = 77 °F, solar spectral irradiance per ASTM E892 (air mass = 1.5).

\*\*Minimum requirements are based on a 100 watt PV panel. Higher wattage PV panels up to and including peak power output of 125 watts is acceptable.

The PV panels shall employ single crystal or multi crystal technology.

The cells shall be textured and coated with an anti reflective film. The cells shall have multiple redundant contacts and shall be electrically matched for increased efficiency.

A rugged aluminum vented backing shall be riveted to an aluminum panel equipped with welded aluminum brackets for attachment to the bracket arm.

Hardware shall be stainless steel.

The PV panels shall provide electrical grounding of all metal surfaces.

### **Batteries**

Batteries shall be maintenance free, sealed, absorbed glass mat, deep cycle, heavy duty. Each battery shall meet the following requirements:

| Parameters                              | Minimum Requirements                        |
|---|---|
| Voltage                                 | 12 V(dc)                                    |
| Storage Capacity                        | 96 A•h minimum at a 100 hour discharge rate |
| Maximum Discharge Current for 5 Seconds | 500 A minimum                               |

### **Load/Charge Controller**

Each load/charge controller shall regulate the voltage and current coming from the photovoltaic panels and going to the batteries and to the load.

Each load/charge controller shall use series regulation.

Each load/charge controller shall meet the following minimum requirements:

| Parameter              | Minimum Requirements                                     |
|------------------------|--|
| Rated Solar Current    | 30 A   |
| Rated Load Current     | 30 A   |
| System Voltage         | 12 or 24 V(dc)   |
| Digital Meter          | Displays Battery Voltage, Solar Current and Load Current |
| Connections            | Screw terminals for PV panels, battery and load          |
| LED Indicators         | Charging, battery status and temperature sensor          |
| Load Disconnect Switch | Can disconnect the load or both the load and solar       |
| Self-test              | Tests all Load/Charge controller internal circuits.      |
| Grounding              | UL Standard 1741   |

## **NEMA 3R Enclosure**

### **General**

The maximum dimensions of each NEMA 3R enclosure shall not exceed those shown on the plans.

### **Enclosure Construction**

Construction of the NEMA 3R enclosures shall be as specified in Section 86-3.04A, "Cabinet Construction," of the Standard Specifications and these special provisions.

The enclosure and doors shall be fabricated of 0.125-inch minimum thickness aluminum.

### **Door Latch**

The door latch shall be either a quarter-turn latch handle with padlock hasp or a zinc-plated draw pull catch with padlock hasp.

### **Enclosure Ventilation**

Ventilation of the NEMA 3R enclosures shall be as specified in Section 86-3.04B, "Cabinet Ventilation," of the Standard Specifications.

Each enclosure shall be provided with louvered vents with a permanent metal mesh or 4 ply woven polypropylene air filter held firmly in place.

### **Enclosure Wiring**

Enclosure wiring within the NEMA 3R enclosures shall be as specified in Section 86-3.04C, "Cabinet Wiring," of the Standard Specifications.

## **CONSTRUCTION**

### **Installation**

The Contractor shall assure that the MVDS will not cause harmful interference to radio communication in the area of the installation as required by FCC Part 15 requirements. The MVDS installations shall be installed such that each installation operates independently and that MVDS installations not interfere with other MVDS installations or other equipment in the vicinity.

The Contractor is responsible for site visits and analysis of each proposed pole location to assure that the detector placement will comply with the manufacturer's published installation instructions, and the performance required in these special provisions. The Contractor shall confirm detector placement with the Engineer before performing work at the MVDS location. When the analysis requires a change in the proposed pole location, the Contractor shall, in consultation with the Engineer and manufacturer's representative, select a new pole location.

The Contractor shall not proceed with any MVDS installation without the Engineer's written approval of the pole location.

The Contractor shall be responsible for the compatibility of components and for making necessary calibration adjustment to deliver the performance required in these special provisions. The Contractor shall provide equipment required to setup, calibrate, verify performance and maintain the MVDS.

The Contractor shall provide programming software needed to support the MVDS. The software shall be installed in the appropriate equipment and used for the acceptance testing.

The SRS shall be installed at Model 332 cabinets as shown on the plans and as directed by the Engineer.

An authorized representative of the SRS manufacturer or vendor shall supervise the installation and testing of the SRS. The Contractor shall inform the Engineer of potential radio interference and recommend relocation of SRS if required.

### **Testing**

#### **General**

A final location acceptance test shall be performed at all finalized locations and the test shall include the accuracy testing of the MVDS.

Accuracy of the MVDS shall be verified by comparing the MVDS vehicle counts to recorded video image counts for the same period. The video camera shall be located and oriented so that traffic is visible in all lanes. Video images shall be date and time stamped and analysis periods recorded to a DVD or CD media for viewing on a PC. The video field of view shall totally encompass the area in which vehicles are detected. The Contractor shall provide a means for synchronizing the test start and test ending times or provide software that displays time stamped MVDS data along with the video images of the moving vehicles. The Contractor shall provide the Engineer with

the original recording medium and documentation that supports the accuracy analysis and make a copy of these materials for their own use.

The accuracy test shall take place during a complex traffic period as specified by the Engineer. The following video recording and analysis options that depend on the available traffic conditions are acceptable; however the heaviest expected traffic conditions should be used, if possible. The minimum recording period shall be 30 minutes when the recording includes congested traffic (vehicles traveling at less than 20 mph for five or more minutes in any lane). The minimum recording period shall be 45 minutes when the traffic flow exceeds 1500 vehicles per hour in any lane during the test period. The minimum recording period shall be 60 minutes when the flow is less than 1500 vehicles per hour in every lane. The analysis shall be based on a minimum of 100 detected vehicles in every lane and cover the same time period for all lanes. The time period within the selected video will be selected by the Engineer. The total vehicle count for every lane shall be used and include the first and last partial vehicles for each lane. Errors in the start and finish of the MVDS and manual counts are included in the performance criterion specified in these special provisions.

MVDS unit count shall be compared to vehicle counts under traffic conditions of the prior paragraph. Vehicles licensed for use on State roads shall be counted by the MVDS. The data accuracy shall be determined by the formula  $100\{1 - [(\text{absolute value } (TC - MC) / TC)]\}$  where TC = Traffic Count derived from the media recording, MC = MVDS reported count over the same period of time, and where the resulting fraction is expressed as an absolute value.

The accuracy of each MVDS sensor unit shall be determined and documented so that each sensor unit may be approved or rejected separately by the Engineer. Failure to submit the materials at the conclusion of testing invalidates the test. The recorded media serves as acceptance evidence and shall not be used for calibration. The calibration shall have been completed prior to testing and verification.

The Engineer will review the accuracy data findings and accept or reject the results within 15 days. Determination of vehicle anomalies or unusual occurrences will be decided by the Engineer. Data or counts that are not accepted by the Engineer shall be considered errors and count against the MVDS sensor unit's calibration. If the Engineer finds that the MVDS does not meet performance requirements, the Contractor shall re-calibrate and re-test the unit and re-submit new test data within 10 days. Following three failed attempts, the Contractor shall replace the MVDS sensor unit with a new unit.

In addition to the accuracy analysis performed by the Contractor, the MVDS shall conform to the requirements specified in "System Testing and Documentation," of these special provisions. The Contractor shall provide equipment, software, documentation, support equipment, and any other materials, personnel and devices that may be required for acceptance testing by the Engineer. The Contractor shall notify the Engineer 15 days before the MVDS sensor unit is ready for acceptance testing. Testing shall be scheduled to be accomplished before the end of the normal work shift.

### **Serial Radio System**

The SRS testing shall include initial tests and subsequent re-tests, if needed, and documentation of the test results. Before testing, all SRS equipment shall be adjusted, aligned and calibrated for the optimum performance. The Contractor shall provide all test equipment including labor, software and auxiliary items required to perform the testing.

At least 15 days in advance of the testing, the Contractor shall submit five copies of the test plan to the Engineer for review. The Contractor shall allow 7 days for Engineer's review.

The Contractor shall notify the Engineer of the intent to proceed with testing 5 business days prior to the commencement of the test. The test plan shall include the following major test and acceptance categories:

1. Physical Inspection - The Contractor shall provide the documents to prove delivery of all material, equipment, cabling and documentation. If any material or documentation is outstanding or had been replaced under pre-acceptance warranty, a physical inspection and documentation shall be provided for this material. The physical inspection shall consist of inspecting of installed material to ensure quality workmanship that satisfies the specified requirements.
2. Functional Demonstration - The Contractor shall demonstrate that the function of all system elements and all equipment satisfy the requirements of system specifications.

The Contractor shall document all functional test results. The transmitters and receivers shall be tested and recorded with the transmitter minimum 22 dBm power and receiver minimum sensitivity -80 dBm. The test results report shall provide the actual signal strength (dBm) between sites and poll testing with data messages.

If, in the opinion of the Engineer, SRS equipment failed functional test, the Contractor shall cease all testing, determine the cause of the failure, and make repairs.

The RF Transceiver Worksheet shown in Appendix A shall be completed for all radio transceivers and access points using the data gathered during the functional testing. The completed worksheets shall be included as part of the system documentation. A laminated copy of the worksheet shall be placed in each cabinet.

## **Training**

### **MVDS Sensor Unit**

The Contractor shall provide a minimum of 4 hours of training by a certified manufacturer's representative for 10 State employees selected by the Engineer. The content of the training shall include instruction on how to align, program, adjust, calibrate and maintain the MVDS sensor unit. Manufacturer shall provide training materials and equipment. The Contractor shall give the Engineer 15 days notice prior to the training. The time and location of the training shall be agreed upon by the Engineer and the Contractor. If no agreement can be reached, the Engineer will determine the time and location.

### **Serial Radio System**

The Contractor shall provide a minimum of 8 hours of training by a certified manufacturer's representative for 10 State employees selected by the Engineer. The content of the training shall include:

1. Overview of SRS elements, theory of operations
2. Installation and configuration steps
3. Set-up, operation, maintenance and troubleshooting of SRS and components
4. Fifteen copies of the technical, user's, and equipment maintenance manuals approved by the manufacturer

The Contractor shall provide materials and equipment for the training.

The Contractor shall give the Engineer 15 days notice prior to the training, and submit a draft of the course material, including all manuals, for review. The Contractor shall allow 7 days for the Engineer to approve or reject the course material. The Contractor shall revise all rejected materials and re-submit for final review and approval.

The time and location of the training shall be agreed upon by the Engineer and the Contractor. If no agreement can be reached, the Engineer will determine the time and location.

**APPENDIX A**  
**RF TRANSCEIVER WORKSHEET**

Contract No. \_\_\_\_\_ Contractor: \_\_\_\_\_

Operator: \_\_\_\_\_ Date: \_\_\_\_\_

Location Description (County/Rte/PostMile): \_\_\_\_\_

**A. Manufacturer Details:**

|                       |  |
|-----------------------|--|
| 1. Manufacturer Name: |  |
| 2. Model No.          |  |

**B. Location Details:**

|                            |                                       |  |
|----------------------------|---------------------------------------|--|
| 1. Unit Type (select one)  | <input type="checkbox"/> Access Point | <input type="checkbox"/> Subscriber Unit |
| 2. Base ID or System Name  |                                       |  |
| 3. AP ID or SU ID          |                                       |  |
| 4. Network IP Address      |                                       |  |
| 5. Network Gateway Address |                                       |  |
| 6. Network Subnet Mask     |                                       |  |
| 7. Network MAC Address     |                                       |  |
| 8. Hardware Version        |                                       |  |
| 9. Firmware Version        |                                       |  |
| 10. Username/Password      |                                       |  |
| 11. GPS Location           | Longitude:                            | Latitude:                                |

**C. SU Association (For Access Point sites only):**

|    |    |     |
|----|----|-----|
| 1. | 5. | 9.  |
| 2. | 6. | 10. |
| 3. | 7. | 11. |
| 4. | 8. | 12. |

**D. RF Signal Details:**

|                       |  |  |
|-----------------------|--|--|
| 1. RSSI from SU (dB)  |  |  |
| 2. RSSI from AP (dB)  |  |  |
| 3. SU TX Power (dBm)  |  |  |
| 4. AP TX Power (dBm)  |  |  |
| 5. Distance from AP   |  |  |
| 6. SU Radio Temp (°C) |  |  |
| 7. Channel #          |  |  |
| 8. Frequency (MHz)    |  |  |

**E. Antenna Details:**

|                         |                                     |   |
|-------------------------|-------------------------------------|---|
| 1. Antenna Manufacturer |                                     |   |
| 2. Antenna Model        |                                     |   |
| 3. Antenna Gain (dBi)   |                                     |   |
| 4. Antenna Type         | <input type="checkbox"/> Integrated | <input type="checkbox"/> External - Type: |
| 7. Polarization         | <input type="checkbox"/> Vertical   | <input type="checkbox"/> Horizontal       |

To Be Completed by Caltrans:

Resident Engineer's Signature: \_\_\_\_\_ Date: \_\_\_\_\_



## **10-3.22 AGGREGATION ETHERNET SWITCH**

### **GENERAL**

#### **Summary**

This work includes installing an aggregation Ethernet switch as shown on the plans and as specified in these special provisions.

#### **Submittals**

Before procurement of the aggregation Ethernet switch, the Contractor shall submit to the Engineer a Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificate of Compliance," of the Standard Specifications.

#### **Functional Requirements**

The aggregation Ethernet switch shall be a fan less industrial-grade managed Ethernet switch capable of providing long range Ethernet communications capabilities for traffic signal controllers and Intelligent Transportation System devices.

#### **Warranty**

The Contractor shall provide the manufacturer's written warranty against defects in materials and workmanship of the aggregation Ethernet switch for a period of 5 years. Replacement of an aggregation Ethernet switch shall be provided within 15 days after receipt of failed units at no cost to the State, except the cost of shipping the failed unit. All warranty documentation shall be given to the Engineer prior to installation. Replacement units shall be delivered to Caltrans-District 4, 111 Grand Ave, Oakland, CA 94612.

### **MATERIALS**

#### **General**

The aggregation Ethernet switch shall be environmentally-hardened unit mountable on nineteen-inch rack.

Hardware, firmware, and software shall be from the same original equipment manufacturer.

Aggregation Ethernet switch shall be compatible with and from the same manufacturer as the backbone Ethernet switch specified in "Backbone Ethernet Switch" and the edge Ethernet switch specified in "Edge Ethernet Switch" of these special provisions.

#### **Standards Compliance**

The aggregation Ethernet switch shall comply with the following data network standards and protocols:

|  |
|--|
| IEEE 802.3-10BaseT                                   |
| IEEE 802.3u- Fast Ethernet 100BaseTX, 100BaseFX      |
| IEEE 802.3z- Gigabit Ethernet 1000Base LX/SX         |
| IEEE 802.3ab- Gigabit Ethernet 1000BaseTX            |
| IEEE 802.3x-Flow Control                             |
| IEEE 802.3ad-Link Aggregation                        |
| IEEE 802.1D-MAC Bridges                              |
| IEEE 802.1D-Spanning Tree Protocol                   |
| IEEE 802.1p-Class of Service, Quality of Service     |
| IEEE 802.1Q-VLAN Tagging                             |
| IEEE 802.1w-Rapid Spanning Tree Protocol             |
| IEEE 802.1x-Port Based Network Access Control        |
| Auto-MDIX  |
| IGMP for Multicast filtering (snooping and querying) |
| SNMP V1/V2/V3  |
| Remote Monitoring (RMON) and Port Mirroring          |

The aggregation Ethernet switch shall comply with the following electrical and mechanical standards:

|  |
|--|
| IEC 60068 2-6, 2-27 – Vibration and Shock                |
| IEC 61850-3, NEMA TS-2 Environment Rating – EMI Immunity |
| UL508 – Electrical Safety                                |
| Electric Substations – IEEE 1613                         |

### **Power Requirements**

Input Voltage Ranges: From 12 to 48 V(dc) and 120 V(ac), with dual redundant power supply connections.

### **Environmental Requirements**

Operating Temperature: From -30 to +70 °C

Relative Humidity (non-condensing): From 10 to 90 percent

### **Features**

Each aggregation Ethernet switch shall include:

1. Web browser based network management software with network topology discovery for configuration
2. Front panel diagnostic LED status indicators indicating device power status, port network link connection and data activity status
3. External Ports:
  - 3.1. Sixteen singlemode fast Ethernet 100Base-FX, SC fiber optic ports (25 km range)
  - 3.2. Eight 8P8C modular fast Ethernet 100Base-TX twisted pair copper ports
  - 3.3. Four slots for SFP Gigabit fiber transceivers
  - 3.4. External USB and serial interface ports for local device configuration and management

### **Components**

Each aggregation Ethernet switch shall be furnished with:

1. Two SFP gigabit fiber transceivers specified in "Small Form Factor Pluggable Fiber Transceiver" of these special provisions
2. Nineteen-inch rack mounting hardware
3. Power supplies
4. Power cables
5. Configuration cables
6. CD ROM containing user and service manuals

## **CONSTRUCTION**

### **Installation**

Aggregation Ethernet switch shall be securely mounted and connected to equipment as shown on the plans and as directed by the Engineer. All cables and wiring shall be clearly labeled.

Aggregation Ethernet switch will be configured by others. After the switch is configured, the Contractor, in coordination with the Engineer, shall ensure that the aggregation Ethernet switch is capable of transmitting and receiving data.

### **Testing**

At least two weeks in advance of testing, the Contractor shall submit the test plan to the Engineer for review and approval. All tests shall be performed by or under supervision of personnel certified by the manufacturer. The Contractor shall provide all test equipment, including labor, software and auxiliary items required to perform the testing. Test results shall be documented and approved by the Engineer.

The test plan shall include:

1. Power meter tests of SFP gigabit transceivers and fast Ethernet fixed optical ports
2. Functionality tests on all copper Ethernet ports
3. Manufacturer recommended tests

Power meter test shall consist of measurements of the SFP transmitter optical output power and SFP receiver optical sensitivity range.

All tested components of the aggregation Ethernet switch shall be shown to meet manufacturer's specifications. If, in the opinion of the Engineer, the equipment fails to pass any performance, and functional test, the Contractor shall cease testing, determine the cause of the failure and either make repairs or replace components at fault. In addition to the tests specified in this section, the aggregation Ethernet switch shall conform to the requirements in "System Testing and Documentation" of these special provisions.

### **10-3.23 BACKBONE ETHERNET SWITCH**

#### **GENERAL**

##### **Summary**

This work includes installing a backbone Ethernet switch in San Mateo hub as shown on the plans and as specified in these special provisions.

##### **Submittals**

Before procurement of the backbone Ethernet switch, the Contractor shall submit to the Engineer a Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificate of Compliance," of the Standard Specifications.

##### **Functional Requirements**

The backbone Ethernet switch shall be a fan less industrial-grade managed layer 3 Ethernet switch capable of providing long range Ethernet communications capabilities for traffic signal controllers and Intelligent Transportation System devices.

##### **Warranty**

The Contractor shall provide the manufacturer's written warranty against defects in materials and workmanship of the backbone Ethernet switch for a period of 5 years. Replacement of backbone Ethernet switch shall be provided within 15 days after receipt of failed units at no cost to the State, except the cost of shipping the failed unit. All warranty documentation shall be given to the Engineer prior to installation. Replacement units shall be delivered to Caltrans-District 4, 111 Grand Ave, Oakland, CA 94612.

#### **MATERIALS**

##### **General**

The backbone Ethernet switch shall be environmentally-hardened unit mountable on nineteen-inch rack.

Hardware, firmware, and software shall be from the same equipment manufacturer.

Backbone Ethernet switch shall be compatible with and from the same manufacturer as the aggregation Ethernet switch specified in "Aggregation Ethernet Switch" and the edge Ethernet switch specified in "Edge Ethernet Switch" of these special provisions.

## Standards Compliance

The backbone Ethernet switch shall comply with the following data network standards and protocols:

|   |
|---|
| IEEE 802.3-10BaseT                                      |
| IEEE 802.3u- Fast Ethernet 100BaseTX, 100BaseFX         |
| IEEE 802.3z- Gigabit Ethernet 1000Base LX/SX            |
| IEEE 802.3ab- Gigabit Ethernet 1000BaseTX               |
| IEEE 802.3x-Flow Control                                |
| IEEE 802.3ad-Link Aggregation                           |
| IEEE 802.1D-MAC Bridges                                 |
| IEEE 802.1D-Spanning Tree Protocol                      |
| IEEE 802.1p-Class of Service, Quality of Service        |
| IEEE 802.1Q-VLAN Tagging                                |
| IEEE 802.1w-Rapid Spanning Tree Protocol                |
| IEEE 802.1x-Port Based Network Access Control           |
| IGMP for Multicast filtering (snooping and querying)    |
| SNMP V1/V2/V3   |
| RMON and Port Mirroring                                 |
| Auto-MDIX   |
| Routing : static routing, layer 3 – Access Control List |
| Router redundancy VRRP, HiRRPv2                         |
| Dynamic routing: RIP V1/2, OSPF                         |
| Multicast routing: DVMRP/PIM DM                         |
| MAC address table: up to 8000 entries                   |

The backbone Ethernet switch shall comply with the following electrical and mechanical standards:

|  |
|--|
| IEC 60068 2-6, 2-27 – Vibration and Shock                |
| IEC 61850-3, NEMA TS-2 Environment Rating – EMI Immunity |
| UL508 – Electrical Safety                                |
| Electric Substations – IEEE 1613                         |

## Power Requirements

Input Voltage Range: From 100 to 240 V(ac), 300 watts, with support for redundant power supply connections.

## Environmental Requirements

Operating Temperature: From -30 to +60 °C

Relative Humidity (non-condensing): From 10 to 90 percent

## Features

The backbone Ethernet switch shall include:

1. Front panel diagnostic LED status indicators indicating device power status, port network link connection and data activity status
2. Microsoft Windows-based network management software with capability to manage and monitor at least 500 Ethernet switches. Network management software shall be from the backbone Ethernet switch manufacturer.
3. External Ports:
  - 3.1. Sixteen 100/1000Base-T 8P8C modular twisted pair copper ports
  - 3.2. External USB and serial interface ports for local device configuration and management
  - 3.3. Three 10 gigabit small form factor pluggable (XFP) slots for XFP fiber transceiver
  - 3.4. Four plug-in media modules. Each plug-in media module shall contain eight SFP ports for SFP gigabit fiber transceivers or SFP fast Ethernet transceivers.

### **Components**

Each backbone Ethernet switch shall be furnished with the following components:

1. Nineteen-inch rack mounting hardware
2. External backbone Ethernet switch power supply unit
3. Power cables
4. Configuration cables
5. CD ROM containing user and service manuals
5. Twenty SFP gigabit fiber transceiver specified in "Small Form Factor Pluggable Fiber Transceiver" of these special provisions
6. Six SFP fast Ethernet fiber transceiver specified in "Small Form Factor Pluggable Fiber Transceiver" of these special provisions

### **External Backbone Ethernet Switch Power Supply Unit**

#### **General**

External backbone Ethernet switch power supply unit (EBESPSU) shall be:

1. Nineteen-inch rack mountable with all mounting hardware included
2. Used to power backbone Ethernet switch
3. Compatible with the backbone Ethernet switch and be approved for use by the backbone Ethernet switch manufacturer
4. Furnished with:
  - 4.1. Three plug-in power modules and slots for their installation
  - 4.2. All cables, connectors and accessories for connecting to backbone Ethernet switch
  - 4.3. User and service manuals provided on CD ROM

#### **Plug-in Power Module**

Plug-in power module shall be:

1. Rated for 100 to 240 V(ac), 47 to 63 Hz, 300 W
2. Redundant and hot swappable

#### **Environmental Requirements**

Operating Temperature: From 0 to 60 °C

### **CONSTRUCTION**

#### **Installation**

Backbone Ethernet switch shall be securely mounted and connected to equipment as shown on the plans and as directed by the Engineer. All cables and wiring shall be clearly labeled.

Backbone Ethernet switch will be configured by others. After the backbone Ethernet switch is configured, the Contractor in coordination with the Engineer, shall ensure that the backbone Ethernet switch is capable of transmitting and receiving data.

#### **Testing**

At least two weeks in advance of testing, the Contractor shall submit the test plan to the Engineer for review and approval. All tests shall be performed by or under supervision of personnel certified by the manufacturer. The Contractor shall provide all test equipment including labor, software and auxiliary items required to perform the testing. Test results shall be documented and approved by the Engineer.

The test plan shall include:

1. Power meter tests of SFP fast Ethernet transceivers and SFP gigabit transceivers
2. Functionality tests on all copper Ethernet ports
3. Manufacturer recommended tests

Power meter test shall consist of measurements of the SFP transmitter optical output power and SFP receiver optical sensitivity range.

All tested components of the backbone Ethernet switch shall be shown to meet manufacturer's specifications. If, in the opinion of the Engineer, the equipment fails to pass any performance and functional test, the Contractor shall cease testing, determine the cause of the failure and either make repairs or replace components at fault to the satisfaction of the Engineer. In addition to the tests specified in this section, the edge Ethernet switch shall conform to the requirements in "System Testing and Documentation" of these special provisions.

### **10-3.23 EDGE ETHERNET SWITCH**

#### **GENERAL**

##### **Summary**

This work includes installing an edge Ethernet switch as shown on the plans and as specified in these special provisions.

##### **Submittals**

Before procurement of the edge Ethernet switch, the Contractor shall submit to the Engineer a Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificate of Compliance," of the Standard Specifications.

##### **Functional Requirements**

The edge Ethernet switch shall be a fanless industrial-grade managed Ethernet switch capable of providing long range Ethernet communications capabilities for traffic signal controllers and Intelligent Transportation System devices.

##### **Warranty**

The Contractor shall provide the manufacturer's written warranty against defects in materials and workmanship of the edge Ethernet switch for a period of 5 years. Replacement of an edge Ethernet switch shall be provided within 15 days after receipt of failed units at no cost to the State, except the cost of shipping the failed unit. All warranty documentation shall be given to the Engineer prior to installation. Replacement units shall be delivered to Caltrans-District 4, 111 Grand Ave, Oakland, CA 94612.

#### **MATERIALS**

##### **General**

The edge Ethernet switch shall be environmentally-hardened, din-rail mountable unit.

Hardware, firmware, and software shall be from the same original equipment manufacturer.

Edge Ethernet switch shall be compatible with and from the same manufacturer as the backbone Ethernet switch specified in "Backbone Ethernet Switch" and the aggregation Ethernet switch specified in "Aggregation Ethernet Switch" of these special provisions.

### Standards Compliance

The edge Ethernet switch shall comply with the following data network standards and protocols:

|  |
|--|
| IEEE 802.3-10BaseT                                   |
| IEEE 802.3u- Fast Ethernet 100BaseTX, 100BaseFX      |
| IEEE 802.3z- Gigabit Ethernet 1000Base LX/SX         |
| IEEE 802.3ab- Gigabit Ethernet 1000BaseTX            |
| IEEE 802.3x-Flow Control                             |
| IEEE 802.3ad-Link Aggregation                        |
| IEEE 802.1D-MAC Bridges                              |
| IEEE 802.1D-Spanning Tree Protocol                   |
| IEEE 802.1p-Class of Service, Quality of Service     |
| IEEE 802.1Q-VLAN Tagging                             |
| IEEE 802.1w-Rapid Spanning Tree Protocol             |
| IEEE 802.1x-Port Based Network Access Control        |
| Auto-MDIX  |
| IGMP for Multicast filtering (snooping and querying) |
| SNMP V1/V2/V3  |
| Remote Monitoring (RMON) and Port Mirroring          |

The edge Ethernet switch shall comply with the following electrical and mechanical standards:

|  |
|--|
| IEC 60068 2-6, 2-27 – Vibration and Shock                |
| IEC 61850-3, NEMA TS-2 Environment Rating – EMI Immunity |
| UL508 – Electrical Safety                                |
| Electric Substations – IEEE 1613                         |

### Power Requirements

Input Voltage Range: From 9.6 to 60 V(dc) or 90 to 265 V(ac), with dual redundant power supply connections.

### Environmental Requirements

Operating Temperature: From -30 to +70 °C

Relative Humidity (non-condensing): From 10 to 90 percent

### Features

The edge Ethernet switch shall include:

1. Web browser based network management software with network topology discovery for configuration
2. Front panel diagnostic LED status indicators indicating device power status, port network link connection and data activity status
3. External Ports:
  - 3.1. Two slots for SFP gigabit fiber transceivers
  - 3.2. Two slots for SFP fast Ethernet fiber transceivers
  - 3.3. Six RJ45 twisted pair copper ports
  - 3.4. External USB and Serial interface ports for local device configuration and management

### Components

Each edge Ethernet switch shall be furnished with:

1. Two SFP fast Ethernet fiber transceivers specified in "Small Form Factor Pluggable Fiber Transceiver" of these special provisions
2. Din-rail adapter with mounting hardware for nineteen inch racks
3. External industrial power supply
4. Power cables
5. Configuration cables

6. CD ROM containing user and service manuals

### **External Industrial Power Supply**

#### **General**

External industrial power supply (EIPS) shall be:

1. Din-rail mountable and environmentally hardened for use in field cabinets
2. Used to power the edge Ethernet switch
3. Compatible with the edge Ethernet switch and be approved for use by the edge Ethernet switch manufacturer
4. with the following specifications:

|                            |  |
|----------------------------|--|
| Output:                    |  |
| DC Voltage:                | 24 V(dc)   |
| Current:                   | 3.33 A   |
| Rated Power:               | 80 Watts   |
| Voltage Adjust (external): | From 24 to 28 V(dc)  |
| Input:                     |  |
| Voltage Range:             | From 100 to 240 V(ac) (±15 percent); 50-60 Hz or<br>From 110 to 300 V(dc) (-20 to +25 percent) |
| Protection:                |  |
| Over-load:                 | From 105 to 150 percent rated output, current limiting with<br>automatic recovery              |
| Over-voltage:              | From 28 to 33 V(dc) shut down output , cycle power to recover                                  |
| Over-temperature:          | +80 °C with automatic recovery   |

5. Compliant with the following Safety Standards:

- 5.1. Safety of industrial control equipment: cUL 508 (E 198865)
- 5.2. Safety of information technology equipment: cUL 60950 (E 137006)
- 5.3. Hazardous locations: UL 1604 Class 1 Div. 2 (E246877)

#### **Connection Requirements**

Voltage Input: 1 Bi-stable, quick-connect spring clamp terminals, 3-pin

Voltage Output: 1 Bi-stable, quick-connect spring clamp terminals, 4-pin

#### **Environmental Requirements**

Operating Temperature Range: From -25 to +70 °C

Storage and Transport Temperature Range: From -40 to +85 °C

Relative Humidity (non-condensing): From 5 to 95 percent

### **CONSTRUCTION**

#### **Installation**

Edge Ethernet switch shall be securely mounted and connected to equipment as shown on the plans and as directed by the Engineer. All cables and wiring shall be clearly labeled.

Edge Ethernet switch will be configured by others. After the edge Ethernet switch is configured, the Contractor in coordination with the Engineer, shall ensure that the edge Ethernet switch is capable of transmitting and receiving data.

#### **Testing**

At least two weeks in advance of testing, the Contractor shall submit the test plan to the Engineer for review and approval. All tests shall be performed by or under supervision of personnel certified by the manufacturer. The Contractor shall provide all test equipment including labor, software and auxiliary items required to perform the testing. Test results shall be documented and approved by the Engineer.



The test plan shall include:

1. Power meter tests of SFP fast Ethernet transceivers
2. Functionality tests on all copper Ethernet ports
3. Manufacturer recommended tests

Power meter test shall consist of measurements of the SFP transmitter optical output power and SFP receiver optical sensitivity range.

All tested components of the edge Ethernet switch shall be shown to meet manufacturer's specifications. If, in the opinion of the Engineer, the equipment fails to pass any performance and functional test, the Contractor shall cease testing, determine the cause of the failure and either make repairs or replace components at fault to the satisfaction of the Engineer. In addition to the tests specified in this section, the Edge Ethernet switch shall conform to the requirements in "System Testing and Documentation" of these special provisions.

### **10-3.24 SMALL FORM FACTOR PLUGGABLE FIBER TRANSCEIVERS**

#### **GENERAL**

##### **Summary**

Small form factor pluggable (SFP) fiber transceivers referenced in "Aggregation Ethernet Switch," "Edge Ethernet Switch," and "Backbone Ethernet Switch" of these special provisions shall be of the following types:

1. SFP gigabit fiber transceiver
2. SFP fast Ethernet fiber transceiver

##### **Submittals**

Before procurement of SFP fiber transceivers, the Contractor shall submit to the Engineer a Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificate of Compliance," of the Standard Specifications.

##### **Functional Requirements**

SFP fiber transceivers shall provide fiber optic based communication links between field edge Ethernet switches, aggregation Ethernet switches and backbone Ethernet Switch.

#### **MATERIALS**

##### **General**

Each SFP fiber transceiver shall be:

1. Compliant with the Industry standard - Multi-Sourcing Agreement (MSA)
2. Installed in the SFP slots of the edge Ethernet switch, aggregation Ethernet switch, and backbone Ethernet switch per manufacturer's guidelines
3. Approved for use with the corresponding Ethernet switch by the switch manufacturer
4. Single-mode with standard duplex LC receptacle
5. Provided with vibration resistance latching mechanism
6. Class 1 Laser, IEC60825 compliant
7. RoHS compliant, lead and hazardous substance free

The Contractor shall provide and install a duplex LC to ST singlemode fiber patch cable for each SFP fiber transceiver.

##### **Power Requirements**

3.3 V(dc) supplied by Ethernet switches

##### **Environmental Requirements**

Operating Temperature: From -30 to +70 °C

## **Type-Specific Requirements**

### **SFP Gigabit Fiber Transceiver**

The SFP gigabit fiber transceiver shall meet the following requirements:

1. Data Rate: Gigabit Ethernet (1000Base-FX) – 1.25 Gbps
2. Data Link Range: From 5 to 42 km over singlemode fiber (SM) 9/125  $\mu\text{m}$ . Data link range shall be based on singlemode fiber 9/125  $\mu\text{m}$  cable, nominal reference link of 0.4 db/km attenuation characteristic.
3. Full compliance with IEEE 802.3 gigabit Ethernet standards

### **Transmitter Optical Characteristics**

1. Output Optical Power: From -5 to 0 dBm
2. Output Center Wavelength: From 1270 to 1360 nm
3. Spectral Width: 1 nm
4. Optical Rise/Fall time 260 ps

### **Receiver Optical Characteristics**

1. Sensitivity: From 0 dBm (minimum) to -22 dBm (maximum)
2. Operating wavelength: From 1270 to 1600 nm
3. Loss of Signal - De-asserted: -22 dBm (maximum)
4. Loss of Signal - Asserted: -32 dBm (minimum)

### **SFP Fast Ethernet Fiber Transceiver**

The SFP fast Ethernet fiber transceiver shall meet the following requirements:

1. Data Rate: Fast Ethernet (100Base-FX) – 155 Mbps
2. Data Link Range: 25 km over singlemode fiber (SM) 9/125  $\mu\text{m}$ . Data link range shall be based on singlemode fiber 9/125  $\mu\text{m}$  cable, nominal reference link of 0.4 db/km attenuation characteristic.
3. Full Compliance with IEEE 802.3 fast Ethernet standards

### **Transmitter Optical Characteristics**

1. Output Optical Power: From -10 to -3 dBm
2. Output Center Wavelength: From 1270 to 1360 nm
3. Spectral Width: 5 nm
4. Optical Rise/Fall Time: 2 ns

### **Receiver Optical Characteristics**

1. Sensitivity: From -30 dBm (minimum) to -3 dBm (maximum)
2. Operating Wavelength: From 1270 to 1600 nm
3. Loss of Signal – De-asserted: -30 dBm (maximum)
4. Loss of Signal - Asserted: - 45 dBm (minimum)

## **10-3.25 SAN MATEO HUB**

### **GENERAL**

#### **Summary**

This work includes relocating existing communication equipment and cabling, installing backbone Ethernet switch and backup signal system server in San Mateo hub as shown on the plans, as specified in these special provisions and as directed by the Engineer.

#### **Work Site Location and Access**

San Mateo hub is located in the telecommunication room of San Mateo Police Department at 200 Franklin Parkway, San Mateo, CA 94403. The Contractor shall coordinate all site work with San Mateo Police Department via the Engineer.

### **MATERIALS**

#### **Backbone Ethernet Switch**

Backbone Ethernet switch shall conform to "Backbone Ethernet Switch" of these special provisions.

### **Backup Signal System Server**

Backup signal system server shall be rack-mountable and have the following minimum features:

1. Dual eight Core 2.5 GHz Processors or approved equivalent
2. Thirty two GB RAM
3. Three hot pluggable 1.5 TB hard drives in RAID configuration
4. 16-X DVD  $\pm$  RW, DL
5. Two 1000 Base-T Ethernet interfaces
6. 512 MB Color Graphics Video Card with dual DVI-I output
7. Seventeen-inch LCD TFT flat screen color monitor with nineteen-inch rackmount hardware
8. Keyboard with nineteen-inch slide-out rackmount tray
9. Optical Mouse
10. Two empty PCI slots
11. Microsoft Windows Server 2008 SP2 or approved equivalent
12. Five year comprehensive warranty
13. Four Port USB/PS2 Keyboard Video Mouse (KVM) Switch with cables
14. Mounting hardware for 19" equipment rack
15. Two redundant power supplies

### **CONSTRUCTION**

#### **Installation**

The Contractor shall abide by all policies and restrictions set forth by the City of San Mateo and City of San Mateo Police Department.

The Contractor shall protect existing equipment within the telecommunication room from damage from the Contractor's operations.

The Contractor shall terminate and connect wires and cables as shown on the plans, and as directed by the Engineer. The Contractor shall furnish and install a minimum of 36 fiber patch cords and 36 network straight-through data cables. All connections shall be documented and clearly labeled.

#### **Testing**

The Contractor shall comply with the requirements in "System Testing and Documentation" of these special provisions.

### **10-3.26 SYSTEM TESTING AND DOCUMENTATION**

#### **GENERAL**

This work includes system testing and documentation of all systems installed as shown on the plans and in accordance with these special provisions. The Contractor shall provide qualified personnel familiar with systems and equipment furnished.

Functionality and performance of each system and equipment installed by the Contractor shall rely on the use of existing systems, where applicable. Existing systems may include interconnecting fiber optic cables, fiber optic termination equipment, data cables, wireless Ethernet links, and Ethernet switches. The Contractor shall not be responsible for resolving identified problems from existing systems, but shall be responsible for identifying and documenting the nature of the problem to the greatest extent possible.

The system testing shall include the following tests and documentations required to validate the operational performance of systems and equipment as shown on the plans and as described elsewhere in these special provisions:

1. Subsystem testing
2. Final acceptance testing
3. Test results documentation
4. System documentation
5. Factory testing documentation
6. Laboratory testing documentation

The Engineer will review, and either approve or reject documents listed in factory and laboratory testing, installation and test plan, and system documentation within 15 working days. If the Engineer rejects a document,

the Contractor shall submit a revised document within 15 working days for review and approval by the Engineer. The Contractor shall provide a minimum of 10 printed copies of all approved documents and one electronic copy.

The Contractor shall notify the Engineer of his intent to proceed with any testing at least 3 working days prior to commencement of each test. The Contractor shall not proceed with any testing without the written approval of the Engineer.

### **INSTALLATION AND TEST PLAN**

Within 30 working days after approval of the Contract, the Contractor shall develop and submit an installation and test plan, which shall include a detailed summary of method(s) of installation and testing for all new equipment, including communications and power cables, and the associated schedule of activities, based on these special provisions, plans, the manufacturer's recommended test procedures, and industry standard practices. Test plans of individual equipment shall conform to requirements described under each individual item elsewhere in these special provisions.

No testing shall be performed until the Engineer has approved the installation and test plan. All system testing results, including results of any failed test and subsequent re-test, shall be submitted to the Engineer. Sub-system testing and inspections shall include visual inspection for correct installation, adjustments and alignment, and measurement of parameters and operating conditions.

### **FACTORY AND LABORATORY TESTING DOCUMENTATION**

Copy of the documentation for factory and laboratory testing conducted at the manufacturer's premises must be submitted to the Engineer.

### **SUB-SYSTEM TESTING**

Sub-system testing shall consist of:

1. Standalone Testing, and
2. Interconnection Testing.

The Contractor shall configure each piece of equipment, as appropriate.

#### **Standalone Testing**

These tests shall be done in accordance with both the installation and test plan and requirements detailed under each individual item in these special provisions. Standalone testing shall include visual inspection for damaged or incorrect installation, adjustments and alignment, and measurement of parameters and operating conditions.

Documentation shall be in accordance with these special provisions and shall include the following, as appropriate:

1. Model, part number and serial number for material
2. Test equipment models number, serial number, settings, and date of last calibration
3. All manual jumper and switch settings
4. Record of adjustments and levels
5. All configuration settings and alignment measurements
6. Identification of interconnections
7. Factory, laboratory, and site test results

#### **Interconnection Testing**

Interconnection testing shall include the following tests:

1. Fiber Optic Cable Testing
2. Data Link Testing

Tests shall be performed in the order as listed. Unless directed by the Engineer, interconnection testing shall not proceed until the completion of the standalone testing described above. After each test, the Contractor shall document the results and submit to the Engineer for approval. If any element fails to satisfy the specified testing requirements, the Contractor shall correct the failure to the satisfaction of the Engineer.

### **Fiber Optic Cable Testing**

Attention is directed to "Fiber Optic Testing" elsewhere in these special provisions.

### **Data Link Testing**

A data link shall include existing and installed communication equipment at the San Mateo hub; edge Ethernet switch, aggregation Ethernet switch, FFOTS, FFORS, and SINE at various locations; interconnecting fiber optic cables, data cables, connectors, and power supplies. The Contractor shall identify each data link that does not meet requirements described in these special provisions including any data link that utilizes existing interconnecting fiber optic cables and equipment. The Contractor shall document the findings and inform the Engineer, but shall not be responsible for repairs to existing cable or equipment installed by others.

The Contractor shall test each data link as specified:

1. Between each SINE and an aggregation Ethernet switch
2. Between each edge Ethernet switch and an aggregation Ethernet switch
3. Between each aggregation switch and a backbone switch in the San Mateo hub.

Data link testing shall consist of the following industry standard tests:

1. Connectivity (Ping) Test
2. Throughput (Bandwidth) Test
3. Latency (Delay) Test
4. Frame Loss (Error) Test

The tests shall be based around RFC 2544 standards and manufacturer recommendations.

The test results shall demonstrate each data link meets industry standard performance measures taking into account the particular type of Ethernet communications equipment, interconnecting fiber optic cables, and data cables installed. Data links involving existing wireless radios shall be noted and exempted from the data link testing.

### **FINAL ACCEPTANCE TESTING**

The final acceptance testing shall be conducted in accordance with the approved installation and test plan and shall include conducting final acceptance tests, as described below, subsequent retest, and documentation of the test results.

Final acceptance tests shall be conducted after the sub-system test results have been reviewed and accepted by the Engineer. The final acceptance testing shall take place in the presence of the Engineer and staff from Caltrans District 4 Office of Electrical Systems.

The final acceptance test plan shall include the following major tests and acceptance categories:

1. Final Inspection

All acceptance test results will be fully documented and approved by the Engineer.

### **Final Inspection**

The Contractor shall provide documentation to prove delivery of all material, equipment, cable, and documentation. If any material or documentation is outstanding or has been replaced under pre-acceptance warranty, a physical inspection and documentation shall be provided for this material. The final inspection shall consist of inspecting all installed material and equipment to ensure workmanship satisfies the specified requirements.

### **FINAL ACCEPTANCE**

The final acceptance of the system(s) shall not occur until each of the following conditions has been met:

1. Final inspection and performance tests have been completed, failures corrected and the Engineer approved the results,
2. All documentation has been completed and submitted to the Engineer, and
3. All connections that were changed to perform acceptance tests are restored and tested.

## **TEST RESULTS DOCUMENTATION**

The test results shall be compiled and recorded in one document. The documents shall be included in "System Documentation."

## **SYSTEM DOCUMENTATION**

The Contractor shall be responsible for all delay caused by non-compliance to the specified requirements.

The Contractor shall develop system documentation providing all the information to the lowest module or component level. Where documents submitted as required elsewhere in these special provisions are relevant, they may be submitted as part of the system documentation.

### **Master Items Index**

This shall be the first section. It shall reference equipment manuals as required for additional and support material.

### **System Description and Technical Data**

This section shall contain an overall description of the systems and associated equipment and cables installed with illustrative block diagrams. This section shall identify all equipment and cables in the system stating the exact module and option number that are employed in the system. Technical data specification and settings for every type of equipment or cable shall be provided. Any modification that has been done on the equipment shall be clearly described. System schematic drawings shall be provided to identify the type of equipment at each location and the function of all equipment. The drawings shall also show how the system is interconnected. A comprehensive list of cabling and wiring shall be provided to clearly identify the interconnection and labeling of all equipment in the field.

### **Theory of Operation**

This section shall contain a functional description of each element of the installed systems, explaining how each function is being achieved separately and how each element works together to form the complete system.

### **Operations**

This section shall describe how to operate the systems and each particular type of equipment and software. Equipment layout, layout of controls, displays, software operating procedures and all other information required to correctly operate the systems and each functional unit shall be provided. Procedures shall also be provided for initial tune-up of the systems and adjustment and checkout required to ensure that the system is functioning within the performance requirements. Warning of special procedures shall be given. The functions and setting of all parameters shall be explained.

### **Corrective Maintenance**

This section shall include fault diagnostic and repair procedures to permit the location and correction of faults to the level of each replaceable module. Procedures shall include alignment and testing of the equipment following repair, the test equipment, tools, diagnostic software required and the test set-up.

### **Preventative Maintenance**

This section shall include procedures for preventative maintenance in order to maintain the performance parameters of the systems, equipment, and cables within the requirements of the specifications.

### **Test Results**

This section shall include a copy of the results for all the tests that have been conducted for the contract.

### **Manufacturer Supplied Manuals and Parts List**

A complete set of manufacturer supplied manuals and parts list shall be provided with each copy of system documentation. Surplus manuals shall be organized by equipment type and provided to the Engineer.

## **10-3.27 REMOVING, REINSTALLING OR SALVAGING ELECTRICAL EQUIPMENT**

Salvaged electrical materials shall be hauled to Caltrans Electrical Maintenance Station, 30 Rickard Street, San Francisco, CA 94134, (415) 330-6500 and stockpiled.

The Contractor shall provide the equipment, as necessary, to safely unload and stockpile the material. A minimum notice of 2 business days shall be given prior to delivery.

### **10-3.28 PAYMENT**

Full compensation for hauling and stockpiling electrical materials shall be considered as included in the contract price paid for the item requiring the material to be salvaged and no additional compensation will be allowed therefor.

If any of the fabrication sites for the materials listed are located more than 300 air line miles from both Sacramento and Los Angeles, additional shop inspection expenses will be sustained by the State. Whereas it is and will be impractical and difficult to determine the actual increase in these expenses, it is agreed that payment to the Contractor for furnishing these listed materials from each fabrication site located more than 300 air line miles from both Sacramento and Los Angeles will be reduced \$2,000:

1. Informational message signs
2. Telephone demarcation cabinets
3. Arterial dynamic message signs

The contract lump sum price paid for traffic operations system at various locations includes full compensation for furnishing all labor, materials (except items covered by other bid items), tools, equipment, and incidentals, and for doing all the work involved in installing traffic operations system at various locations, complete in place, including concrete foundations (except if shown as a separate contract item), ADMS and IMS mounting structures CCTV poles, manuals and traffic operations system equipment testing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract unit price paid for each of the following items includes full compensation for furnishing all materials, tools, equipment, and incidentals, as shown on the plans, as specified in these special provisions, and as directed by the Engineer:

1. Camera control unit
2. Video encoder unit
3. Informational message sign assembly
4. Arterial dynamic message sign panel and assembly
5. Closed circuit television (fixed) camera unit
6. Closed circuit television (pan/tilt/zoom) camera unit
7. EDGE Ethernet switch
8. Aggregation Ethernet switch
9. Signal interconnect network element
10. Microwave vehicle detection system

The contract lump sum price paid for fiber optic system includes full compensation for furnishing all labor, materials (except if shown as a separate contract item), tools, equipment, and incidentals, and for doing all the work involved in installing fiber optic system, complete in place, including all the splices, splice vaults, manuals and testing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract lump sum price paid for San Mateo hub includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in San Mateo hub, complete in place, including small form factor pluggable fiber transceiver, backbone Ethernet switch, manuals and testing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract lump sum price paid for system testing and documentation includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in system testing and documentation, complete in place, including manuals and testing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

## **SECTION 11. (BLANK)**

## **SECTION 12. (BLANK)**

## **SECTION 13. RAILROAD RELATIONS AND INSURANCE**

### **13-1.01 GENERAL**

The Contractor's attention is directed to the tracks and right-of-way of the Peninsula Corridor Joint Powers Board (Caltrain) and the Union Pacific Railroad (UPRR), at the Redwood Junction Overhead, Bridge No. 35-0052 on State Route 84 in San Mateo County, hereinafter referred to as "Railroads," within the limits of the project.

In accordance with the provisions in Section 7-1.12, "Indemnification and Insurance," of the Standard Specifications, the Contractor shall be responsible for all damages to Railroads' track and equipment operating on such track, resulting from his operations.

The Contractor shall not allow any personnel or equipment on Railroads' tracks or right of way.

The Contractor shall conduct his operation in a manner that will prevent debris or any other material from falling onto the tracks and right of way of the Railroads.



**AMENDMENTS TO THE STANDARD SPECIFICATIONS  
DATED MAY 2006**



## AMENDMENTS ISSUE DATE: 10-19-12

### SECTION 0 GLOBAL REVISIONS

(Issued 01-20-12)

Global revisions are changes to contract documents not specific to a section of the Standard Specifications. In each contract document at each occurrence, interpret the following terms as shown:

| Term   | Interpretation   | Conditions   |
|--|--|--|
| AC   | HMA  | 1. Where AC means asphalt concrete<br>2. Except where existing AC is described |
| Asphalt concrete   | Hot mix asphalt  | Except where existing asphalt concrete is described                            |
| Class 1 concrete   | Concrete containing not less than 675 pounds of cementitious material per cubic yard | --   |
| Class 2 concrete   | Concrete containing not less than 590 pounds of cementitious material per cubic yard | --   |
| Class 3 concrete   | Concrete containing not less than 505 pounds of cementitious material per cubic yard | --   |
| Class 4 concrete   | Concrete containing not less than 420 pounds of cementitious material per cubic yard | --   |
| Clause providing an option to use either a class concrete or minor concrete              | Use minor concrete   | --   |
| Clause referring to a delay as a right-of-way delay                                      | Delay under Section 8-1.09, "Delays"   | --   |
| Contact joint  | Construction joint   | --   |
| Controlling operation  | Controlling activity   | --   |
| Engineer's Estimate  | Verified Bid Item List   | --   |
| Engineering fabrics  | Geosynthetics  | --   |
| Notice to Contractors  | Notice to Bidders  | --   |
| Partial payments   | Progress payments  | Except in Section 9-1.07D, "Mobilization"                                      |
| PCC pavement   | Concrete pavement  | Except where existing PCC pavement is described                                |
| Portland cement concrete pavement  | Concrete pavement  | Except where existing portland cement concrete pavement is described           |
| Project information  | Supplemental project information   | Except in "Contract Project Information Signs"                                 |
| Reference to a working day or non-working day under Section 8-1.06, "Time of Completion" | Working day as defined in Section 1-4.02, "Glossary"                                 | --   |
| Section 9-1.015  | Section 9-1.01C  | --   |
| Section 86, "Signal, Lighting and Electrical Systems"                                    | Section 86, "Electrical Systems"   | --   |
| Section 86-2.08, "Conductors"  | Section 86-2.08, "Conductors and Cables"   | --   |
| Section 86-5.01A(5), "Installation Details"  | Section 86-5.01A(4),   | --   |

|  |   |    |
|--|---|----|
|  | "Installation Details"                                    |    |
| Section 86-6.05, "Sign Lighting Fixtures—Mercury"  | Section 86-6.05, "Induction Sign Lighting Fixtures"       | -- |
| Time extension due to an unanticipated event not caused by either party or an issue involving a third party under Section 8-1.07, "Liquidated Damages" | Non-working day   | -- |
| Time extension due to an act of the Engineer or of the Department not contemplated by the contract   | Time adjustment under Section 8-1.09B, "Time Adjustments" | -- |
| Weakened plane joint   | Contraction joint   | -- |

^^

## SECTION 1 DEFINITIONS AND TERMS

(Issued 06-20-12)

**Replace Section 1 with:**

### SECTION 1 GENERAL

#### 1-1 GENERAL

##### 1-1.01 GENERAL

Section 1 includes general rules of interpretation.

The Department is gradually standardizing the style and language of the specifications. The new style and language includes:

1. Use of:
  - 1.1. Imperative mood
  - 1.2. Introductory modifiers
  - 1.3. Conditional clauses
2. Elimination of:
  - 2.1. Language variations
  - 2.2. Definitions for industry-standard terms
  - 2.3. Redundant specifications
  - 2.4. Needless cross-references

The use of this new style does not change the meaning of a specification not yet using this style.

Sections 1 through 9 include general specifications applicable to every contract unless specified as applicable under certain conditions.

Sections 10 through 15 include specifications for general construction applicable to every contract unless specified as applicable under certain conditions.

The specifications are written to the Bidder before award and the Contractor after. Before award, interpret sentences written in the imperative mood as starting with "The Bidder must" and interpret "you" as "the Bidder" and "your" as "the Bidder's." After award, interpret sentences written in the imperative mood as starting with "The Contractor must" and interpret "you" as "the Contractor" and "your" as "the Contractor's."

Omission of "a," "an," and "the" is intentional. These articles have been omitted in some specifications for streamlining purposes.

Unless an object or activity is specified to be less than the total, the quantity or amount is all of the object or activity.

A plural term includes the singular.

All items in a list apply unless the items are specified as choices.

Headings are included for the purposes of organization and referencing. Inclusion of a heading with no related content, "Reserved," or "Not Used" does not indicate that no specification exists for that subject; applicable specifications may be covered in a general or referenced specification.

## **1-2 REFERENCES**

### **1-2.01 REFERENCES**

Where Standard Specifications refer to the special provisions to describe the work, interpret the reference as a reference to the Bid Item List, the special provisions, or both.

Interpret a reference to a section of the Standard Specifications as a reference to the Standard Specifications as revised by any amendment, special provision, or both.

A reference within parentheses to a law or regulation is included in the contract for convenience only and is not a comprehensive listing of related laws and regulations. Lack of a reference does not indicate no related laws or regulations exist.

Where the version of a referenced document is not specified, use the current version in effect on the date of Notice to Bidders.

A reference to a subsection includes the section's general specifications of which the subsection is a part.

A code not specified as a Federal code is a California code.

## 1-3 ABBREVIATIONS AND MEASUREMENT UNITS

### 1-3.01 ABBREVIATIONS

| <b>Abbreviations</b> |  |
|----------------------|--|
| Abbreviation         | Meaning  |
| AAN                  | American Association of Nurserymen                                     |
| AASHTO               | American Association of State Highway and Transportation Officials     |
| AISC                 | American Institute of Steel Construction                               |
| AISI                 | American Iron and Steel Institute                                      |
| AMA                  | archaeological monitoring area   |
| ANSI                 | American National Standards Institute                                  |
| APHA                 | American Public Health Association                                     |
| API                  | American Petroleum Institute   |
| AREMA                | American Railway Engineering and Maintenance-of-Way Association        |
| ASME                 | American Society of Mechanical Engineers                               |
| ASTM                 | American Society for Testing and Materials                             |
| AWG                  | American Wire Gage   |
| AWPA                 | American Wood-Preservers' Association                                  |
| AWS                  | American Welding Society   |
| AWWA                 | American Water Works Association                                       |
| CIH                  | Certified Industrial Hygienist   |
| DBE                  | Disadvantaged Business Enterprise                                      |
| DVBE                 | Disabled Veteran Business Enterprise                                   |
| EIA                  | Electronic Industries Alliance   |
| ESA                  | environmentally sensitive area   |
| ETL                  | Electrical Testing Laboratories  |
| (F)                  | final pay item   |
| FHWA                 | Federal Highway Administration   |
| IEEE                 | Institute of Electrical and Electronics Engineers                      |
| ITE                  | Institute of Transportation Engineers                                  |
| NEC                  | National Electrical Code   |
| NETA                 | National Electrical Testing Association, Inc.                          |
| NEMA                 | National Electrical Manufacturers Association                          |
| PLAC                 | permit, license, agreement, certification, or any combination of these |
| RFI                  | request for information  |
| SSPC                 | The Society for Protective Coatings                                    |
| TIA                  | time impact analysis   |
| UL                   | Underwriters' Laboratories Inc.  |

### 1-3.02 MEASUREMENT UNITS

| Measurement Units                     |                                      |                             |
|---------------------------------------|--------------------------------------|-----------------------------|
| Symbols as used in the specifications | Symbols as used in the Bid Item List | Meaning                     |
| A                                     | —                                    | amperes                     |
|                                       | ACRE                                 | acre                        |
|                                       | CF                                   | cubic foot                  |
|                                       | CY                                   | cubic yard                  |
| --                                    | EA                                   | each                        |
| g                                     | --                                   | gram                        |
| ksi                                   | --                                   | kips per square inch        |
|                                       | GAL                                  | gallon                      |
| h                                     | H                                    | hour                        |
|                                       | LB                                   | pound                       |
| --                                    | LS                                   | lump sum                    |
|                                       | LF                                   | linear foot                 |
|                                       | LNMI                                 | lane mile                   |
|                                       | MFBM                                 | thousand foot board measure |
|                                       | MI                                   | mile                        |
|                                       | MSYD                                 | thousand station yard       |
| Ω                                     | --                                   | ohm                         |
| pcf                                   | --                                   | pounds per cubic foot       |
| s                                     | --                                   | second                      |
|                                       | STA                                  | 100 feet                    |
|                                       | SQFT                                 | square foot                 |
|                                       | SQYD                                 | square yard                 |
|                                       | TAB                                  | tablet                      |
| ton                                   | TON                                  | 2,000 pounds                |
| V                                     | --                                   | volt                        |
| W                                     | --                                   | watt                        |
| --                                    | WDAY                                 | working day                 |

### 1-4 DEFINITIONS

#### 1-4.01 GENERAL

Interpret terms as defined in the contract documents. A construction-industry term not defined in the contract documents has the meaning defined in Means Illustrated Construction Dictionary, Condensed Version, Second Edition.

#### 1-4.02 GLOSSARY

**aerially deposited lead:** Lead primarily from vehicle emissions deposited within unpaved areas or formerly unpaved areas.

**archaeological monitoring area:** Area within, near, or straddling the project limits where access is allowed, but work is subject to archaeological monitoring.

**archaeological resources:** Remains of past human activity, including historic and prehistoric material (e.g., tools and tool fragments, hearth and food remains, structural remains, and human remains).

**acceptance:** Formal written acceptance by the Director of an entire contract that has been completed in all respects in accordance with the plans and specifications and any modifications to them previously approved.

**base:** Layer of specified material of planned thickness placed immediately below the pavement or surfacing.

**basement material:** Material in excavation or embankments underlying the lowest layer of subbase, base, pavement, surfacing, or other specified layer to be placed.

**bid item:** Specific work unit for which the bidder provides a price.

**Bid Item List:** List of bid items and the associated quantities.

**Bid Item List, verified:** Bid Item List with verified prices. The Contract Proposal of Low Bidder at the Department's Web site is the verified Bid Item List.

**bridge:** Structure, with a bridge number, that carries a utility facility, or railroad, highway, pedestrian or other traffic, over a water course or over or under or around any obstruction.

**building-construction contract:** Contract that has "building construction" on the cover of the Notice to Bidders and Special Provisions.

**business day:** Day on the calendar except Saturday or holiday.

**California Manual on Uniform Traffic Control Devices:** The California Manual on Uniform Traffic Control Devices for Streets and Highways (California MUTCD) is issued by the Department of Transportation and is the Federal Highway Administration's MUTCD 2003 Edition, as amended for use in California.

**Certified Industrial Hygienist:** Industrial hygienist certified in comprehensive practice by the American Board of Industrial Hygiene.

**conduit:** Pipe or tube in which smaller pipes, tubes, or electrical conductors are inserted or are to be inserted.

**contract:** Written and executed contract between the Department and the Contractor.

**contract bonds:** Security for the payment of workers and suppliers furnishing materials, labor, and services and for guaranteeing the Contractor's work performance.

**contract item:** Bid item.

**Contractor:** Person or business or its legal representative entering into a contract with the Department for performance of the work.

**culvert:** Structure, other than a bridge, that provides an opening under a roadway for drainage or other purposes.

**day:** 24 consecutive hours running from midnight to midnight; calendar day.

**deduction:** Amount of money permanently taken from progress payment and final payment. Deductions are not retentions under Pub Cont Code § 7107.

**Department:** Department of Transportation as defined in St & Hwy Code § 20 and authorized in St & Hwy Code § 90; its authorized representatives.

**detour:** Temporary route for traffic around a closed road part. A passageway through a job site is not a detour.

**Director:** Department's Director.

**Disabled Veteran Business Enterprise:** Business certified as a DVBE by the Office of Small Business and DVBE Services, Department of General Services.

**Disadvantaged Business Enterprise:** Disadvantaged Business Enterprise as defined in 49 CFR 26.5.

**divided highway:** Highway with separated traveled ways for traffic, generally in opposite directions.

**Engineer:** Department's Chief Engineer acting either directly or through properly authorized agents; the agents acting within the scope of the particular duties delegated to them.

**environmentally sensitive area:** Area within, near, or straddling the project limits where access is prohibited or limited to protect environmental resources.

**Federal-aid contract:** Contract that has a Federal-aid project number on the cover of the Notice to Bidders and Special Provisions.

**fixed costs:** Labor, material, or equipment cost directly incurred by the Contractor as a result of performing or supplying a particular bid item that remains constant regardless of the item's quantity.

**frontage road:** Local street or road auxiliary to and located generally on the side of an arterial highway for service to abutting property and adjacent areas and for control of access.

**grading plane:** Basement material surface on which the lowest layer of subbase, base, pavement, surfacing, or other specified layer is placed.

**highway:** Whole right of way or area that is reserved for and secured for use in constructing the roadway and its appurtenances.

**holiday:**

1. Every Sunday
2. January 1st, New Year's Day
3. 3rd Monday in January, Birthday of Martin Luther King, Jr.
4. February 12th, Lincoln's Birthday
5. 3rd Monday in February, Washington's Birthday
6. March 31st, Cesar Chavez Day
7. Last Monday in May, Memorial Day
8. July 4th, Independence Day
9. 1st Monday in September, Labor Day
10. 2nd Monday in October, Columbus Day
11. November 11th, Veterans Day
12. 4th Thursday in November, Thanksgiving Day
13. Day after Thanksgiving Day
14. December 25th, Christmas Day



If January 1st, February 12th, March 31st, July 4th, November 11th, or December 25th falls on a Sunday, the Monday following is a holiday. If November 11th falls on a Saturday, the preceding Friday is a holiday. Interpret "legal holiday" as "holiday."

**idle equipment:** Equipment:

1. On the job site at the start of a delay
2. Idled because of the delay
3. Not operated during the delay

**informal-bid contract:** Contract that has "Informal Bid Authorized by Pub Cont Code §10122" on the cover of the Notice to Bidders and Special Provisions.

**Information Handout:** Supplemental project information furnished to bidders as a handout.

**laboratory:** Laboratory authorized by the Department to test materials.

**liquidated damages:** Amount prescribed in the specifications, pursuant to the authority of Pub Cont Code § 10226, to be paid to the State or to be deducted for each day's delay in completing the whole or any specified portion of the work beyond the time allowed in the specifications.

**listed species:** Any species listed as threatened or endangered under (1) Federal Endangered Species Act of 1973, 16 USC §1531 et seq., (2) California Endangered Species Act, Fish & Game Code §§ 2050–2115.5, (3) or both.

**material shortage:** Shortage of raw or produced material that is area-wide and caused by an unusual market condition, except if any of the following occurs:

1. Shortage relates to a produced, nonstandard material
2. Supplier's and the Contractor's priority for filling an order differs
3. Event outside the U.S. for a material produced outside the U.S.

**median:** Portion of a divided highway separating the traveled ways for traffic in opposite directions including inside shoulders.

**mobilization:** Preparatory work that must be performed or costs incurred before starting work on the various items on the job site (Pub Cont Code § 10104).

**Notice to Bidders:** Document that provides a general work description, bidder and bid specifications, and the time and location the Department receives bids.

**paleontological resources:** Fossils and the deposits they are found in. Fossils are evidence of ancient life preserved in sediments and rock. Examples of paleontological resources are remains of (1) animals, (2) animal tracks, (3) plants, and (4) other organisms. Archaeological resources are not paleontological and fossils found within an archaeological resource are generally considered archaeological resources, not paleontological resources.

**pavement:** Uppermost layer of material placed on the traveled way or shoulders. This term is used interchangeably with surfacing.

**permitted biological activities:** Monitoring, surveying, or other practices that require a take permit and project specific permission from U.S. Fish and Wildlife Service or NOAA Fisheries or a take permit or Memorandum of Understanding with Department of Fish and Game.

**plans:** Official project plans and Standard Plans, profiles, typical cross sections, working drawings and supplemental drawings, or reproductions thereof, approved by the Engineer, which show the location, character, dimensions and details of the work to be performed. These documents are to be considered as a part of the plans.

In the above definition, the following terms are defined as follows:

**Standard Plans:** Standard Plans issued by the Department.

**project plans:** Specific details and dimensions peculiar to the work supplemented by the Standard Plans insofar as the same may apply.

**protective radius:** Minimum distance between construction activities and regulated species.

**regulated species:** Any species protected by one or any combination of the following:

1. Federal Endangered Species Act of 1973, 16 USC §1531 et seq.
2. California Endangered Species Act, Fish & Game Code §§2050–2115.5
3. Fish & Game Code §§1600–1616
4. National Environmental Policy Act, 42 USC §4321 et seq.
5. California Environmental Quality Act, Pub Res Code § 21000 et.seq.
6. Other law or regulation that governs activities that affect species or their habitats.

**roadbed:** Area between the intersection of the upper surface of the roadway and the side slopes or curb lines. The roadbed rises in elevation as each increment or layer of subbase, base, surfacing or pavement is placed. Where the medians are so wide as to include areas of undisturbed land, a divided highway is considered as including 2 separate roadbeds.

**roadway:** Highway portion included between the outside lines of sidewalks, or curbs, slopes, ditches, channels, waterways, and including all the appertaining structures, and other features necessary to proper drainage and protection.

**routine biological activities:** Biological monitoring, surveying, or other activity that does not require a take permit from the U.S. Fish and Wildlife Service or NOAA Fisheries or a take permit or Memorandum of Understanding with Department of Fish and Game.

**service-approved biologist:** Biologist whose activities must be approved by a state or federal agency as provided in PLACs.

**shoulder:** Roadway portion contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

**small tool:** Tool or piece of equipment not listed in Labor Surcharge and Equipment Rental Rates that has a replacement value of \$500 or less.

**special provisions:** Specific clauses setting forth conditions or requirements peculiar to the work and supplementary to these Standard Specifications. The Department's publication titled "Labor Surcharge And Equipment Rental Rates" is part of the special provisions.

**specifications:** Directions, provisions, and requirements contained in these Standard Specifications, Amendments to the Standard Specifications, and the special provisions. Where the term "these specifications" or "these Standard Specifications" is used in this book, it means the provisions set forth in this book.

**State:** State of California, including its agencies, departments, or divisions, whose conduct or action is related to the work.

**Structure Design:** Offices of Structure Design of the Department.

**subbase:** Layer of specified material of planned thickness between a base and the basement material.

**subgrade:** Roadbed portion on which pavement, surfacing, base, subbase, or a layer of any other material is placed.

**substructure:** Bridge portions below the bridge seats, tops of piers, haunches of rigid frames, or below the spring lines of arches. Backwalls and parapets of abutments and wingwalls of bridges are portions of the substructure.

**superstructure:** Bridge portion except the bridge substructure.

**supplemental project information:** Information relevant to the project, specified as supplemental project information, and made available to bidders.

**surfacing:** Uppermost layer of material placed on the traveled way, or shoulders. This term is used interchangeably with pavement.

**take:** Legal definition regarding harm to listed species as defined in 16 USC §1532 and Fish & Game Code § 86.

**take permit:** Permit granted by the US Fish and Wildlife Service or by the NOAA Fisheries that allows take of federal listed species under 16 USC §1539 or by the Department of Fish & Game that allows take of state listed species under to Fish & Game Code § 2081.

**traffic lane:** Portion of a traveled way for the movement of a single line of vehicles.

**traveled way:** Portion of the roadway for the movement of vehicles, exclusive of shoulders.

**total bid:** Sum of the item totals as verified by the Department; original contract price.

**withhold:** Money temporarily or permanently taken from progress payment. Withholds are not retentions under Pub Cont Code § 7107.

**work:** All the work specified, indicated, shown or contemplated in the contract to construct the improvement, including all alterations, amendments, or extensions to it made by contract change order or other written orders of the Engineer.

**working day:** Time measure unit for work progress. A working day is any day except:

1. Saturdays and holidays
2. A day when you cannot perform work on the controlling activity for at least 50 percent of the day with at least 50 percent of the normal labor and equipment due to any of the following:
  - 2.1. Adverse weather-related conditions that cause you to dismiss the crew
  - 2.2. Maintaining traffic under the contract

- 2.3. The Engineer's direction to suspend the controlling activities for reasons unrelated to your performance
- 2.4. An unanticipated event not caused by either party such as:
  - 2.4.1. Act of God (Pub Cont Code § 7105)
  - 2.4.2. Act of a public enemy
  - 2.4.3. Epidemic
  - 2.4.4. Fire
  - 2.4.5. Flood
  - 2.4.6. Governor-declared state of emergency
  - 2.4.7. Landslide
  - 2.4.8. Quarantine restriction
- 2.5. An issue involving a third-party, including:
  - 2.5.1. Industry or area-wide labor strike
  - 2.5.2. Material shortage
  - 2.5.3. Freight embargo
  - 2.5.4. Jurisdictional requirement of a law enforcement agency
  - 2.5.5. Workforce labor dispute of a utility or non-highway facility owner resulting in a utility or non-highway facility reconstruction not described and not solely for the Contractor's convenience

## 1-5 DISTRICTS

**District Composition and Office Addresses**

| District | Counties   | Location Address                           | Mailing Address                                   |
|----------|--|--|---|
| 1        | Del Norte (DN), Humboldt (Hum), Lake (Lak), Mendocino (Men)  | 1656 UNION ST<br>EUREKA, CA                | PO BOX 3700<br>EUREKA CA 95502                    |
| 2        | Lassen (Las), Modoc (Mod), Plumas (Plu), Shasta (Sha), Siskiyou (Sis), Tehama (Teh), Trinity (Tri)   | 1657 RIVERSIDE DR<br>REDDING, CA           | PO BOX 496073<br>REDDING CA 96049-6073            |
| 3        | Butte (But), Colusa (Col), El Dorado (ED), Glenn (Gle), Nevada (Nev), Placer (Pla), Sacramento (Sac), Sierra (Sie), Sutter (Sut), Yolo (Yol), Yuba (Yub) | 703 B ST<br>MARYSVILLE, CA                 | 703 B ST<br>MARYSVILLE CA 95901                   |
| 4        | Alameda (Ala), Contra Costa (CC), Marin (Mrn), Napa (Nap), San Francisco (SF), San Mateo (SM), Santa Clara (SCI), Solano (Sol), Sonoma (Son)             | 111 GRAND AVE<br>OAKLAND, CA               | PO BOX 23660<br>OAKLAND CA 94623-0660             |
| 5        | Monterey (Mon), San Benito (SBt), San Luis Obispo (SLO), Santa Barbara (SB), Santa Cruz (SCr)  | 50 HIGUERA ST<br>SAN LUIS OBISPO, CA       | 50 HIGUERA ST<br>SAN LUIS OBISPO CA 93401-5415    |
| 6        | Fresno (Fre), Kern (Ker), Kings (Kin), Madera (Mad), Tulare (Tul)  | 1352 W. OLIVE AVE<br>FRESNO, CA            | PO BOX 12616<br>FRESNO CA 93728-2616              |
| 7        | Los Angeles (LA), Ventura (Ven)  | 100 S. MAIN ST<br>LOS ANGELES              | 100 S MAIN ST<br>LOS ANGELES CA 90012             |
| 8        | Riverside (Riv), San Bernardino (SBd)  | 464 W 4TH ST<br>SAN BERNARDINO, CA         | 464 W 4TH ST<br>SAN BERNARDINO CA 92401-1400      |
| 9        | Inyo (Iny), Mono (Mno)   | 500 S MAIN ST<br>BISHOP, CA                | 500 S MAIN ST<br>BISHOP CA 93514-3423             |
| 10       | Alpine (Alp), Amador (Ama), Calaveras (Cal), Mariposa (Mpa), Merced (Mer), San Joaquin (SJ), Stanislaus (Sta), Tuolumne (Tuo)                            | 1976 E CHARTER WAY<br>STOCKTON, CA         | PO BOX 2048<br>STOCKTON CA 95201                  |
| 11       | Imperial (Imp), San Diego (SD)   | 4050 TAYLOR ST<br>SAN DIEGO, CA            | 4050 TAYLOR ST<br>SAN DIEGO CA 92110-2737         |
| 12       | Orange (Ora)   | 3347 MICHELSON DR<br>STE 100<br>IRVINE, CA | 3347 MICHELSON DR STE 100<br>IRVINE CA 92612-0661 |

A project with work in District 1, 2, or 3 is a North Region project. For Districts 1, 2, and 3, interpret each reference to the district office as the North Region office. The North Region office address is the District 3 address.

## 1-6 WEB SITES, ADDRESSES, AND TELEPHONE NUMBERS

| Web Sites, Addresses, and Telephone Numbers                                |   |   |                                  |
|--|---|---|----------------------------------|
| Agency, Department Unit, or Reference                                      | Web Site  | Address   | Telephone No.                    |
| Bidders' Exchange  | <a href="http://www.dot.ca.gov/hq/esc/oe/bidex">www.dot.ca.gov/hq/esc/oe/bidex</a>  | MSC 26<br>BIDDERS' EXCHANGE<br>DEPARTMENT OF<br>TRANSPORTATION<br>1727 30TH ST<br>SACRAMENTO CA 95816-7005  | (916) 227-6259                   |
| Department   | <a href="http://www.dot.ca.gov">www.dot.ca.gov</a>  |   |                                  |
| Department of General Services, Office of Small Business and DVBE Services | <a href="http://www.pd.dgs.ca.gov/smbus/default.htm">www.pd.dgs.ca.gov/smbus/default.htm</a>  | OFFICE OF SMALL BUSINESS AND<br>DVBE SERVICES<br>DEPARTMENT OF GENERAL<br>SERVICES<br>707 3RD ST<br>WEST SACRAMENTO CA 95605-<br>2811   | (800) 559-5529<br>(916) 375-4940 |
| Department of Industrial Relations   | <a href="http://www.dir.ca.gov">www.dir.ca.gov</a>  |   |                                  |
| Department of Industrial Relations, Division of Apprenticeship Standards   |   | 455 GOLDEN GATE AVENUE<br>SAN FRANCISCO, CA 94102   |                                  |
| Division of Accounting, Office of External Accounts Payable                | <a href="http://www.dot.ca.gov/hq/asc/oap/payments/contact.htm#conpets1">http://www.dot.ca.gov/hq/asc/oap/payments/contact.htm#conpets1</a> | MAJOR CONSTRUCTION PAYMENT<br>AND INFORMATION UNIT<br>OFFICE OF EXTERNAL ACCOUNTS<br>PAYABLE<br>DIVISION OF ACCOUNTING<br>DEPARTMENT OF<br>TRANSPORTATION<br>P.O. BOX 168043<br>SACRAMENTO, CA 95816-8043 | (916) 227-9013                   |
| Office Engineer  |   | MSC 43<br>OFFICE ENGINEER<br>DEPARTMENT OF<br>TRANSPORTATION<br>1727 30TH ST<br>SACRAMENTO CA 95816-7005  |                                  |
| Office Engineer--All Projects Currently Advertised                         | <a href="http://www.dot.ca.gov/hq/esc/oe/weekly_ads/all_advertised.php">http://www.dot.ca.gov/hq/esc/oe/weekly_ads/all_advertised.php</a>   |   |                                  |
| Offices of Structure Design, Documents Unit                                |   | MSC 9-4/4I<br>DOCUMENTS UNIT OFFICES OF<br>STRUCTURE DESIGN<br>DEPARTMENT OF<br>TRANSPORTATION<br>1801 30TH ST<br>SACRAMENTO CA 95816-7006  | (916) 227-0716                   |
| Publication Distribution Unit  |   | PUBLICATION UNIT<br>DEPARTMENT OF<br>TRANSPORTATION<br>1900 ROYAL OAKS DRIVE<br>SACRAMENTO CA 95815-3800  |                                  |



For rock cores, also include the bridge number in your request.  
If bridge as-built drawings are available:

1. For a project in District 1 through 6 or 10, you may request them from the Office of Structure Maintenance and Investigations, fax (916) 227-8357
2. For a project in District 7, 8, 9, 11, or 12, you may request them from the Office of Structure Maintenance and Investigations, fax (916) 227-8357, and they are available at the Office of Structure Maintenance and Investigations, Los Angeles, CA, telephone (213) 897-0877

As-built drawings may not show existing dimensions and conditions. Where new construction dimensions are dependent on existing bridge dimensions, verify the field dimensions and adjust dimensions of the work to fit existing conditions.

## **2-1.04–2-1.10 RESERVED**

### **2-1.11 JOB SITE AND DOCUMENT EXAMINATION**

Examine the job site and bid documents.

Bid submission is your acknowledgment that you have examined the job site and bid documents and are satisfied with:

1. General and local conditions to be encountered
2. Character, quality, and scope of work to be performed
3. Quantities of materials to be furnished
4. Character, quality, and quantity of surface and subsurface materials or obstacles
5. Requirements of the contract

### **2-1.12 BID DOCUMENT COMPLETION**

#### **2-1.12A General**

Complete forms in the Bid book.

Except for the bid item number and the percentage of each item subcontracted, do not fax submittals.

#### **2-1.12B Bid Item List and Bid Comparison**

Submit a bid based on the work item quantities the Department shows in the Bid Item List.

For a lump sum based bid, the Department compares bids based on the total price.

For a unit price based bid, the Department compares bids based on the sum of the item totals.

For a cost plus time based bid, the Department compares bids based on the sum of the item totals and the total bid for time. If your bid for time exceeds the number of working days described in the Notice to Bidders, your bid is nonresponsive.

#### **2-1.12C Subcontractor List**

In the Subcontractor List, list each subcontractor to perform work in an amount in excess of 1/2 of 1 percent of the total bid or \$10,000, whichever is greater (Pub Cont Code § 4100 et seq.)

The Subcontractor List must show the name, address, and work portions to be performed by each subcontractor listed. Show work portion by bid item number, description, and percentage of each bid item subcontracted.

On the Subcontractor List you may either submit each subcontracted bid item number and corresponding percentage with your bid or fax these numbers and percentages to (916) 227-6282 within 24 hours after bid opening. Failure to do so results in a nonresponsive bid.

### **2-1.13 BIDDER'S SECURITY**

Submit your bid with one of the following forms of bidder's security equal to at least 10 percent of the bid:

1. Cash
2. Cashier's check
3. Certified check
4. Bidder's bond signed by a surety insurer who is licensed in California

If using a bidder's bond, you may use the form in the Bid book. If you do not use the form in the Bid book, use a form containing the same information.



**Replace Section 3 with:**

**SECTION 3 CONTRACT AWARD AND EXECUTION**

**3-1.01 SCOPE**

Section 3, "Contract Award and Execution," includes specifications related to contract award and execution.

**3-1.02 CONTRACT AWARD**

Submit any bid protest to the Office Engineer.

If the Department awards the contract, the award is made to the lowest responsible bidder within the number of days shown in the following table:

| <b>Contract Award Period</b>        |  |
|-------------------------------------|--|
| <b>Days<br/>(after bid opening)</b> | <b>Project Estimated Cost shown in the<br/>Notice to Bidders</b> |
| 30                                  | < \$200 million  |
| 60                                  | ≥ \$200 million  |

The Department may extend the specified award period if the bidder agrees.

You may request to extend the award period by faxing a request to (916) 227-6282 before 4:00 p.m. on the last day of the award period. If you do not make this request, after the specified award period:

1. Your bid becomes invalid
2. You are not eligible for the award of the contract

**3-1.03 CONTRACT BONDS (PUB CONT CODE §§ 10221 AND 10222)**

The successful bidder must furnish:

1. Payment bond to secure the claim payments of laborers, workers, mechanics, or materialmen providing goods, labor, or services under the contract. This bond must be equal to at least 100 percent of the total bid.
2. Performance bond to guarantee the faithful performance of the contract. This bond must be equal to at least 50 percent of the total bid.

The Department furnishes the successful bidder with the bond forms.

**3-1.04 CONTRACTOR LICENSE**

For a Federal-aid contract, the Bidder must be properly licensed (Pub Cont Code § 10164) from contract award through contract acceptance.

For a non-Federal-aid contract:

1. The Bidder must be properly licensed from bid opening through contract acceptance (Bus & Prof Code § 7028.15)
2. Joint venture bidders must obtain a joint venture license before contract award (Bus & Prof Code § 7029.1)

**3-1.05 INSURANCE POLICIES**

The successful bidder must submit:

1. Copy of its commercial general liability policy and its excess policy or binder until such time as a policy is available, including the declarations page, applicable endorsements, riders, and other modifications in effect at the time of contract execution. Standard ISO form No. CG 0001 or similar exclusions are allowed if not inconsistent with Section 7-1.12, "Indemnification and Insurance." Allowance of additional exclusions is at the discretion of the Department.
2. Certificate of insurance showing all other required coverages. Certificates of insurance, as evidence of required insurance for the auto liability and any other required policy, shall set forth deductible amounts applicable to each policy and all exclusions that are added by endorsement to each policy. The evidence of insurance shall provide that no cancellation, lapse, or reduction of coverage will occur without 10 days prior written notice to the Department.

3. A declaration under the penalty of perjury by a CPA certifying the accountant has applied GAAP guidelines confirming the successful bidder has sufficient funds and resources to cover any self-insured retentions if the self-insured retention is over \$50,000.

If the successful bidder uses any form of self-insurance for workers compensation in lieu of an insurance policy, it shall submit a certificate of consent to self-insure under Labor Code § 3700.

### **3-1.06 FORM FHWA-1273**

For a federal-aid contract, form FHWA-1273 is included with the Contract form in the documents sent to the successful bidder for execution. Comply with its provisions. Interpret the training and promotion section as specified in section 7-1.50A.

### **3-1.07–3-1.08 RESERVED**

### **3-1.09 CONTRACT EXECUTION**

The successful bidder must sign the contract and return it, including the attached form FHWA-1273, to the Office Engineer along with:

1. Contract bonds
2. Documents identified in Section 3-1.05, "Insurance Policies"

For an informal-bid contract, the Office Engineer must receive these documents before the 5th business day after the bidder receives the contract. For all other contracts, the Office Engineer must receive these documents before the 10th business day after the bidder receives the contract.

The bidder's security may be forfeited for failure to execute the contract within the time specified (Pub Cont Code §§ 10181, 10182, and 10183).

The following is a copy of the Contract form:



STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
CONTRACT NO. \_\_\_\_\_

This contract is entered into between the State of California's Department of Transportation and the Contractor named below:

\_\_\_\_\_  
CONTRACTOR'S NAME

The parties agree to comply with the terms of the following exhibits that are by this reference made a part of this contract.

Exhibit A - Bid book dated \_\_\_\_\_

Exhibit B - Notice to Bidders and Special Provisions dated \_\_\_\_\_

Exhibit C - Project Plans approved \_\_\_\_\_

Exhibit D - Standard Specifications dated \_\_\_\_\_

Exhibit E - Standard Plans dated \_\_\_\_\_

Exhibit F - Addenda \_\_\_\_\_

Exhibits A, B, C, and F are those exhibits identified with the same contract number as this contract.

**This contract has been executed by the following parties:**

**CONTRACTOR**

\_\_\_\_\_  
CONTRACTOR'S NAME (If other than an individual, state whether a corporation, partnership, etc.)

BY (Authorized Signature)

\_\_\_\_\_  
DATE SIGNED (Do not type)

\_\_\_\_\_  
PRINTED NAME AND TITLE OF PERSON SIGNING

\_\_\_\_\_  
FEDERAL EMPLOYER IDENTIFICATION NUMBER

\_\_\_\_\_  
LICENSE NUMBER

**DEPARTMENT OF TRANSPORTATION**

\_\_\_\_\_  
BY (Authorized Signature)

\_\_\_\_\_  
DATE SIGNED (Do not type)

\_\_\_\_\_  
PRINTED NAME AND TITLE OF PERSON SIGNING

**This contract has been certified as complying with the State Contract Act:**

\_\_\_\_\_  
BY (Authorized Signature)

\_\_\_\_\_  
DATE SIGNED (Do not type)

\_\_\_\_\_  
PRINTED NAME AND TITLE OF PERSON SIGNING

**ADA Notice** For individuals with sensory disabilities, this document is available in alternate formats. For information call (916) 654-6410 or TDD (916) 654-3880 or write Records and Forms Management, 1120 N Street, MS-89, Sacramento, CA 95814.

The Department keeps the securities of the 1st, 2nd, and 3rd low bidders until the contract has been executed. The other bidders' securities, other than bidders' bonds, are returned upon determination of the 1st, 2nd, and 3rd low bidders, and their bidders' bonds are of no further effect (Pub Cont Code § 10184).

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remaining portion of the work will be classed as extra work. Extra work also includes work specifically designated as extra work in the plans or specifications.

**Add:**

**4-1.035 VALUE ENGINEERING**

**4-1.035A General**

Reserved

**4-1.035B Value Engineering Change Proposal**

You may submit a VECP to reduce any of the following:

1. Total cost of construction
2. Construction activity duration
3. Traffic congestion

Before preparing a VECP, meet with the Engineer to discuss:

1. Proposal concept
2. Permit issues
3. Impact on other projects
4. Project impacts, including traffic, schedule, and later stages
5. Peer reviews
6. Overall proposal merits
7. Review times required by the Department and other agencies

The VECP must not impair the project's essential functions or characteristics, such as:

1. Service life
2. Operation economy
3. Maintenance ease
4. Desired appearance
5. Design and safety

The VECP must include:

1. Description of the contract specifications and drawing details for performing the work and the proposed changes.
2. Itemization of contract specifications and drawing details that would be changed.
3. Detailed cost estimate for performing the work under the existing contract and under the proposed change. Determine the estimates under Section 9-1.03, "Force Account Payment."
4. Deadline for the Engineer to decide on the changes.
5. Bid items affected and resulting quantity changes.

The Department is not required to consider a VECP. If a VECP is similar to a change in the plans or specifications being considered by the Department at the time the proposal is submitted or if the proposal is based on or similar to drawings or specifications adopted by the Department before Contract award, the Department does not accept the VECP and may make these changes without VECP payments.

Until the Department approves a change order incorporating the VECP or parts of it, continue to perform the work under the contract. If the Department does not approve a change order before the deadline stated in the VECP or other date you subsequently stated in writing, the VECP is rejected. The Department does not adjust time or payment for a rejected VECP.

The Department decides whether to accept a VECP and the estimated net construction-cost savings from adopting the VECP or parts of it.

The Department may require you to accept a share of the investigation cost as a condition of reviewing a VECP. After written acceptance, the Department considers the VECP and deducts the agreed cost.

If the Department accepts the VECP or parts of it, the Department issues a change order that:

1. Incorporates changes in the contract necessary to implement the VECP or the parts adopted
2. Includes the Department's acceptance conditions
3. States the estimated net construction-cost savings resulting from the VECP
4. Obligates the Department to pay you 50 percent of the estimated net savings

In determining the estimated net construction-cost savings, the Department excludes your VECP preparation cost and the Department's VECP investigation cost, including parts paid by you.

If a VECF providing for a reduction in working days is accepted by the Department, 50 percent of the reduction is deducted from contract time.

If a VECP providing for a reduction in traffic congestion or avoiding traffic congestion is accepted by the Department, the Department pays 60 percent of the estimated net savings in construction costs attributable to the VECP. Submit detailed traffic handling comparisons between the existing contract and the proposed change, including estimates of the traffic volumes and congestion.

The Department may apply an accepted VECP for general use on other contracts.

If an accepted VECP is adopted for general use, the Department pays only the contractor who first submitted the VECP and only to the contracts awarded to that contractor before the submission of the accepted VECP.

If the Department does not adopt a general-use VECP, an identical or similar submitted proposal is eligible for acceptance.

## 4-1.035C Value Analysis Workshop

Section 4-1.035C, "Value Analysis Workshop," applies to a non-building-work contract with a total bid of over \$5 million.

You may request a value analysis workshop by submitting a request after contract approval.

The Department offers a value analysis workshop to:

1. Identify value enhancing opportunities
2. Consider changes to the contract that will reduce the total cost of construction, construction activity duration, or traffic congestion without impairing the essential functions specified for a VECP in Section 4-1.035B, "Value Engineering Change Proposal."

If the request is authorized, you and the Engineer:

1. Schedule a value analysis workshop
2. Select a facilitator and workshop site
3. Agree to other workshop administrative details

The workshop must be conducted under the methods described in the Department's Value Analysis Team Guide available at:

<http://www.dot.ca.gov/hq/oppd/value/>

The facilitator must be a certified value specialist as recognized by the Society of American Value Engineers.

The Department reimburses you for 1/2 of the workshop cost. The workshop cost is the sum of the workshop-facilitator cost and the workshop-site cost. The Department determines the workshop cost based on the facilitator and workshop-site invoice prices minus any available or offered discounts. The Department does not pay you for any other associated costs.

[illegible]

## SECTION 5 CONTROL OF WORK

**(Issued 06-01-11)**

**Add:**

**5-1.005 GENERAL**

Failure to comply with any specification part is a waiver of your right to an adjustment of time and payment related to that part.

After contract approval, submit documents and direct questions to the Engineer. Orders, approvals, authorizations, and requests to the Contractor are by the Engineer.

The Engineer furnishes the following in writing:

1. Approvals
2. Authorizations
3. Certifications
4. Decisions
5. Notifications
6. Orders
7. Responses

The Contractor must furnish the following in writing:

1. Assignments
2. Notifications
3. Proposals
4. Reports
5. Requests, including RFIs, sequentially numbered
6. Subcontracts
7. Test results

The Department rejects a form if it has any error or any omission.

Convert foreign language documents to English.

Use contract administration forms available at the Department's Web site.

If the last day for submitting a document falls on a Saturday or holiday, it may be submitted on the next business day with the same effect as if it had been submitted on the day specified.

**Add to 5-1.01:**

Failure to enforce a contract provision does not waive enforcement of any contract provision.

**Add:**

**5-1.011 PROTESTS**

You may protest an Engineer's decision by submitting an RFI under Section 5-1.145, "Requests for Information."

**Add:**

**5-1.012 PARTNERING**

**5-1.012A General**

The Department strives to work cooperatively with all contractors; partnering is our way of doing business. The Department encourages project partnering among the project team, made up of significant contributors from the Department and the Contractor, and their invited stakeholders.

For a project with a total bid greater than \$1 million, professionally facilitated project partnering is encouraged.

For a project with a total bid greater than \$10 million, professionally facilitated project partnering is required.

In implementing project partnering, you and the Engineer manage the contract by:

1. Using early and regular communication with involved parties
2. Establishing and maintaining a relationship of shared trust, equity, and commitment
3. Identifying, quantifying, and supporting attainment of mutual goals
4. Developing strategies for using risk management concepts

5. Implementing timely communication and decision making
6. Resolving potential problems at the lowest possible level to avoid negative impacts
7. Holding periodic partnering meetings and workshops as appropriate to maintain partnering relationships and benefits throughout the life of the project
8. Establishing periodic joint evaluations of the partnering process and attainment of mutual goals

Partnering does not void any contract part.

The Department's "Field Guide to Partnering on Caltrans Construction Projects" current at the time of bid is available to the project team as reference. This guide provides structure, context, and clarity to the partnering process requirements. This guide is available at the Department's Partnering Program website:

<http://www.dot.ca.gov/hq/construc/partnering.html>

In implementing project partnering, the project team must:

1. Create a partnering charter that includes:
  - 1.1. Mutual goals, including core project goals and may also include project-specific goals and mutually supported individual goals.
  - 1.2. Partnering maintenance and close-out plan.
  - 1.3. Dispute resolution plan that includes a dispute resolution ladder and may also include use of facilitated dispute resolution sessions.
  - 1.4. Team commitment statement and signatures.
2. Participate in monthly partnering evaluation surveys to measure progress on mutual goals and may also measure short-term key issues as they arise.
3. Evaluate the partnering facilitator on Forms CEM-5501 and CEM-5502. The Engineer provides the evaluation forms to the project team and collects the results. The Department makes evaluation results available upon request. Facilitator evaluations must be completed:
  - 3.1. At the end of the initial partnering workshop on Form CEM-5501.
  - 3.2. At the end of the project close-out partnering workshop on Form CEM-5502.
4. Conduct a project close-out partnering workshop.
5. Document lessons learned before contract acceptance.

#### **5-1.012B Partnering Facilitator, Workshops, and Monthly Evaluation Surveys**

The Engineer sends you a written invitation to enter into a partnering relationship after contract approval. Respond within 15 days to accept the invitation and request the initial and additional partnering workshops. After the Engineer receives the request, you and the Engineer cooperatively:

1. Select a partnering facilitator that offers the service of a monthly partnering evaluation survey with a 5-point rating and agrees to follow the Department's "Partnering Facilitator Standards and Expectations" available at the Department's Partnering Program website
2. Schedule initial partnering workshop
3. Determine initial workshop site and duration
4. Agree to other workshop administrative details

Additional partnering workshops and sessions are encouraged throughout the life of the project as determined necessary by you and the Engineer, recommended quarterly.

#### **5-1.012C Training in Partnering Skills Development**

For a project with a total bid of \$25 million or greater, training in partnering skills development is required.

For a project with a total bid between \$10 million and \$25 million, training in partnering skills is optional.

You and the Engineer cooperatively schedule the training session and select a professional trainer, training site, and 1 to 4 topics from the following list to be covered in the training:



1. Active Listening
2. Building Teams
3. Change Management
4. Communication
5. Conflict Resolution
6. Cultural Diversity
7. Dealing with Difficult People
8. Decision Making
9. Effective Escalation Ladders
10. Emotional Intelligence
11. Empathy
12. Ethics
13. Facilitation Skills
14. Leadership
15. Partnering Process and Concepts
16. Project Management
17. Project Organization
18. Problem Solving
19. Running Effective Meetings
20. Time Management
21. Win-Win Negotiation

Before the initial partnering workshop, the trainer conducts a 1-day training session in partnering skills development for the Contractor's and the Engineer's representatives. This training session must be a separate session from the initial partnering workshop and must be conducted locally. The training session must be consistent with the partnering principles under the Department's "Field Guide to Partnering on Caltrans Construction Projects."

Send at least 2 representatives to the training session. One of these must be your assigned representative as specified in Section 5-1.06, "Superintendence," of the Standard Specifications.

#### **5-1.012D Payment**

The Department pays you for:

1. 1/2 of partnering workshops and sessions based on facilitator and workshop site cost
2. 1/2 of monthly partnering evaluation survey service cost
3. Partnering skills development trainer and training site cost

The Department determines the costs based on invoice prices minus any available or offered discounts. The Department does not pay markups on these costs.

The Department does not pay for wages, travel expenses, or other costs associated with the partnering workshops and sessions, monthly partnering evaluation surveys, and training in partnering skills development.

#### **Add:**

#### **5-1.015 RECORDS**

##### **5-1.015A General**

Reserved

##### **5-1.015B Record Retention**

Retain project records from bid preparation through:

1. Final payment
2. Resolution of claims, if any

For at least 3 years after the later of these, retain cost records, including records of:

1. Bid preparation
2. Overhead
3. Payrolls

4. Payments to suppliers and subcontractors
5. Cost accounting

Maintain the records in an organized way in the original format, electronic and hard copy, conducive to professional review and audit.

#### **5-1.015C Record Inspection, Copying, and Auditing**

Make your records available for inspection, copying, and auditing by State representatives for the same time frame specified under Section 5-1.015B, "Record Retention." The records of subcontractors and suppliers must be made available for inspection, copying, and auditing by State representatives for the same period. Before contract acceptance, the State representative notifies the Contractor, subcontractor, or supplier 5 business days before inspection, copying, or auditing.

If an audit is to start more than 30 days after contract acceptance, the State representative notifies the Contractor, subcontractor, or supplier when the audit is to start.

#### **5-1.015D Cost Accounting Records**

Maintain cost accounting records for the project distinguishing between the following work cost categories:

1. Work performed based on bid item prices
2. Work performed by change order other than extra work. Distinguish this work by:
  - 2.1. Bid item prices
  - 2.2. Force account
  - 2.3. Agreed price
3. Extra work. Distinguish extra work by:
  - 3.1. Bid item prices
  - 3.2. Force account
  - 3.3. Agreed price
  - 3.4. Specialist billing
4. Work performed under potential claim records
5. Overhead
6. Subcontractors, suppliers, owner-operators, and professional services

Cost accounting records must include:

1. Final cost code lists and definitions
2. Itemization of the materials used and corresponding vendor's invoice copies
3. Direct cost of labor
4. Equipment rental charges
5. Workers' certified payrolls
6. Equipment:
  - 6.1. Size
  - 6.2. Type
  - 6.3. Identification number
  - 6.4. Hours operated

#### **5-1.015E Extra Work Bills**

Maintain separate records for costs of work performed by change order.

Within 7 days after performing the work, submit extra work bills using the Department's Internet extra work billing system.

The Contractor submitting and the Engineer approving an extra work bill using the Internet force account work billing system is the same as each party signing the bill.

The Department provides billing system:

1. Training within 30 days of your written request
2. Accounts and user identification to your assigned representatives after a representative has received training

Each representative must maintain a unique password.

**Replace Section 5-1.04 with:**

**5-1.04 CONTRACT COMPONENTS**

A component in one contract part applies as if appearing in each. The parts are complementary and describe and provide for a complete work.

If a discrepancy exists:

1. The governing ranking of contract parts in descending order is:
  - 1.1. Special provisions
  - 1.2. Project plans
  - 1.3. Revised Standard Plans
  - 1.4. Standard Plans
  - 1.5. Amendments to the Standard Specifications
  - 1.6. Standard Specifications
  - 1.7. Supplemental project information
2. Written numbers and notes on a drawing govern over graphics
3. A detail drawing governs over a general drawing
4. A detail specification governs over a general specification
5. A specification in a section governs over a specification referenced by that section

If a discrepancy is found or confusion arises, request correction or clarification.

**Add:**

**5-1.055 SUBCONTRACTING**

**5-1.055A General**

No subcontract releases you from the contract or relieves you of your responsibility for a subcontractor's work.

If you violate Pub Cont Code § 4100 et seq., the Department may exercise the remedies provided under Pub Cont Code § 4110. The Department may refer the violation to the Contractors State License Board as provided under Pub Cont Code § 4111.

Except for a building-construction non-federal-aid contract, perform work equaling at least 30 percent of the value of the original total bid with your employees and with equipment owned or rented by you, with or without operators.

Each subcontract must comply with the contract.

The Department encourages you to include a dispute resolution process in each subcontract.

Each subcontractor must have an active and valid State contractor's license with a classification appropriate for the work to be performed (Bus & Prof Code, § 7000 et seq.).

Submit copies of subcontracts upon request.

Before subcontracted work starts, submit a Subcontracting Request form.

Do not use a debarred contractor; a current list of debarred contractors is available at the Department of Industrial Relations' Web site.

Upon request, immediately remove and not again use a subcontractor who fails to prosecute the work satisfactorily.

**Replace Section 5-1.07 with:**

**5-1.07 LINES AND GRADES**

The Engineer places stakes and marks under Chapter 12, "Construction Surveys," of the Department's Surveys Manual.

Submit your request for Department-furnished stakes:

1. On a Request for Construction Stakes form. Ensure:
  - 1.1. Requested staking area is ready for stakes
  - 1.2. You use the stakes in a reasonable time
2. A reasonable time before starting an activity using the stakes

Establish priorities for stakes and note priorities on the request.

Preserve stakes and marks placed by the Engineer. If the stakes or marks are destroyed, the Engineer replaces them at the Engineer's earliest convenience and deducts the cost.

**Replace Section 5-1.10 with:**

**5-1.10 EQUIPMENT**

Clearly stencil or stamp at a clearly visible location on each piece of equipment except hand tools an identifying number and:

1. On compacting equipment, its make, model number, and empty gross weight that is either the producer's rated weight or the scale weight
2. On meters and on the load-receiving element and indicators of each scale, the make, model, serial number, and producer's rated capacity

Submit a list:

1. Describing each piece of equipment
2. Showing its identifying number

Upon request, submit producer's information that designates portable vehicle scale capacities.

For proportioning materials, use measuring devices, material plant controllers, and undersupports complying with Section 9-1.01B, "Weighing Equipment and Procedures."

Measuring devices must be tested and approved under California Test 109 in the Department's presence by any of the following:

1. County Sealer of Weights and Measures
2. Scale Service Agency
3. Division of Measurement Standards Official

The indicator over-travel must be at least 1/3 of the loading travel. The indicators must be enclosed against moisture and dust.

Group measuring system dials such that the smallest increment for each indicator can be read from the location at which proportioning is controlled.

**Replace Section 5-1.116 with:**

**5-1.116 DIFFERING SITE CONDITIONS (23 CFR 635.109)**

**5-1.116A Contractor's Notification**

Promptly notify the Engineer if you find either of the following:

1. Physical conditions differing materially from either of the following:
  - 1.1. Contract documents
  - 1.2. Job site examination
2. Physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the contract

Include details explaining the information you relied on and the material differences you discovered.

If you fail to notify the Engineer promptly, you waive the differing site condition claim for the period between your discovery of the differing site condition and your notification to the Engineer.

If you disturb the site after discovery and before the Engineer's investigation, you waive the differing site condition claim.

#### **5-1.116B Engineer's Investigation and Decision**

Upon your notification, the Engineer investigates job site conditions and:

1. Notifies you whether to resume affected work
2. Decides whether the condition differs materially and is cause for an adjustment of time, payment, or both

You may protest the Engineer's decision.

#### **Replace Section 5-1.14 with:**

#### **5-1.14 COST REDUCTION INCENTIVE**

Comply with Section 4-1.035B, "Value Engineering Change Proposal."

#### **Add:**

#### **5-1.145 REQUESTS FOR INFORMATION**

Submit an RFI upon recognition of any event or question of fact arising under the Contract.

The Engineer responds to the RFI within 5 days. Proceed with the work unless otherwise ordered. You may protest the Engineer's response by:

1. Submitting an Initial Potential Claim Record within 5 days after receipt of the Engineer's response
2. Complying with Section 5-1.146, "Potential Claims and Dispute Resolution"

#### **Add:**

#### **5-1.146 POTENTIAL CLAIMS AND DISPUTE RESOLUTION**

##### **5-1.146A General**

Minimize and mitigate impacts of potentially claimed work or event.

For each potential claim, assign an identification number determined by chronological sequencing and the 1st date of the potential claim.

Use the identification number for each potential claim on the:

1. Initial Potential Claim Record
2. Supplemental Potential Claim Record
3. Full and Final Potential Claim Record

Failure to comply with this procedure is:

1. Waiver of the potential claim and a waiver of the right to a corresponding claim for the disputed work in the administrative claim procedure
2. Bar to arbitration (Pub Cont Code § 10240.2)

##### **5-1.146B Initial Potential Claim Record**

Submit an Initial Potential Claim Record within 5 days of the Engineer's response to the RFI or within 5 days from the date when a dispute arises due to an act or failure to act by the Engineer. The Initial Potential Claim Record establishes the claim nature and circumstances. The claim nature and circumstances must remain consistent.

The Engineer responds within 5 days of the date of the Initial Potential Claim Record. Proceed with the potentially claimed work unless ordered.

Within 20 days of a request, provide access to the project records determined necessary by the Engineer to evaluate the potential claim.

#### **5-1.146C Supplemental Potential Claim Record**

Within 15 days of submitting the Initial Potential Claim Record, submit a Supplemental Potential Claim Record including:

1. Complete nature and circumstances causing the potential claim or event
2. Contract specifications supporting the basis of a claim
3. Estimated claim cost and an itemized breakdown of individual costs stating how the estimate was determined
4. TIA

The Engineer evaluates the Supplemental Potential Claim Record and furnishes you a response within 20 days of submittal. If the estimated cost or effect on the scheduled completion date changes, update the Supplemental Potential Claim Record information as soon as the change is recognized and submit this information.

#### **5-1.146D Full and Final Potential Claim Record**

Notify the Engineer within 10 days of the completion date of the potentially claimed work. The Engineer approves this completion date or notifies you of a revised date.

Within 30 days of the completion of the potentially claimed work, submit a Full and Final Potential Claim Record including:

1. A detailed factual account of the events causing the potential claim, including:
  - 1.1. Necessary dates
  - 1.2. Locations
  - 1.3. Work items affected by the potential claim
2. The Contract documents supporting the potential claim and a statement of the reasons these parts support entitlement
3. If a payment adjustment is requested, an itemized cost breakdown. Segregate costs into the following categories:
  - 3.1. Labor, including:
    - 3.1.1. Individuals
    - 3.1.2. Classifications
    - 3.1.3. Regular and overtime hours worked
    - 3.1.4. Dates worked
  - 3.2. Materials, including:
    - 3.2.1. Invoices
    - 3.2.2. Purchase orders
    - 3.2.3. Location of materials either stored or incorporated into the work
    - 3.2.4. Dates materials were transported to the job site or incorporated into the work
  - 3.3. Equipment, including:
    - 3.3.1. Detailed descriptions, including make, model, and serial number
    - 3.3.2. Hours of use
    - 3.3.3. Dates of use
    - 3.3.4. Equipment rates at the rental rate listed in Labor Surcharge and Equipment Rental Rates in effect when the affected work related to the claim was performed
4. If a time adjustment is requested:
  - 4.1. Dates for the requested time.
  - 4.2. Reasons for a time adjustment.
  - 4.3. Contract documentation supporting the requested time adjustment.

- 4.4. TIA. The TIA must demonstrate entitlement to a time adjustment.
5. Identification and copies of your documents and copies of communications supporting the potential claim, including certified payrolls, bills, cancelled checks, job cost reports, payment records, and rental agreements
6. Relevant information, references, and arguments that support the potential claim

The Department does not consider a Full and Final Potential Claim Record that does not have the same nature, circumstances, and basis of claim as those specified on the Initial Potential Claim Record and Supplemental Potential Claim Record.

The Engineer evaluates the information presented in the Full and Final Potential Claim Record and furnishes you a response within 30 days of its receipt unless the Full and Final Potential Claim Record is submitted after Contract acceptance; in which case, a response may not be furnished. The Engineer's receipt of the Full and Final Potential Claim Record must be evidenced by postal return receipt or the Engineer's written receipt if delivered by hand.

#### **5-1.146E Dispute Resolution**

Comply with Section 5-1.15, "Dispute Resolution."

**Add:**

### **5-1.15 DISPUTE RESOLUTION**

#### **5-1.15A General**

Section 5-1.15, "Dispute Resolution," applies to a contract with 100 or more working days.

The dispute resolution process is not a substitute for the submitting an RFI or a potential claim record.

#### **5-1.15B Dispute Resolution Advisor**

Section 5-1.15B, "Dispute Resolution Advisor," applies to a contract with a total bid from \$3 million to \$10 million.

A dispute resolution advisor, hereinafter referred to as "DRA," is chosen by the Department and the Contractor to assist in the resolution of disputes.

The DRA shall be established by the Department and the Contractor within 30 days of contract approval.

The Department and the Contractor shall each propose 3 potential DRA candidates. Each potential candidate shall provide the Department and the Contractor with their disclosure statement. The disclosure statement shall include a resume of the potential candidate's experience and a declaration statement describing past, present, anticipated, and planned relationships with all parties involved in this contract.

The Department and the Contractor shall select one of the 6 nominees to be the DRA. If the Department and the Contractor cannot agree on one candidate, the Department and the Contractor shall each choose one of the 3 nominated by the other. The final selection of the DRA will be decided by a coin toss between the two candidates.

The Department and the Contractor shall complete and adhere to the Dispute Resolution Advisor Agreement. No DRA meeting shall take place until the Dispute Resolution Advisor Agreement has been signed by all parties, unless all parties agree to sign it at the first meeting.

If DRA needs outside technical services, technical services shall be preapproved by both the Department and the Contractor.

DRA recommendations are nonbinding.

The Contractor shall not use the DRA for disputes between subcontractors or suppliers that have no grounds for a lawsuit against the Department.

DRA replacement is selected in the same manner as the original selection. The appointment of a replacement DRA will begin promptly upon determination of the need for replacement. The Dispute Resolution Advisor Agreement shall be amended to reflect the change of the DRA.

Failure of the Contractor to participate in selecting DRA will result in the withhold of 25 percent of the estimated value of all work performed during each estimate period that the Contractor fails to comply. DRA withholds will be released for payment on the next monthly progress payment following the date that the Contractor has provided assistance in choosing the DRA and no interest will be due the Contractor.

The State and the Contractor shall bear the costs and expenses of the DRA equally.

The DRA shall be compensated at an agreed rate of \$1,500 per day for time spent per meeting either at the start of the project or for a dispute. A member serving on more than one State DRA or Dispute Resolution Board, regardless the number of meetings per day shall not be paid more than the agreed rate per day. The agreed rate shall

be considered full compensation for on-site time, travel expenses, transportation, lodging, time for travel, and incidentals for each day or portion thereof that the DRA is at an authorized DRA meeting.

No additional compensation will be made for time spent by the DRA to review and research activities outside the official DRA meetings unless that time, such as time spent evaluating and preparing recommendations on specific issues presented to the DRA, has been specifically agreed to in advance by the State and Contractor. Time away from the project that has been specifically agreed to in advance by the Department and the Contractor will be compensated at an agreed rate of \$150 per hour. The agreed amount of \$150 per hour shall include all incidentals including expenses for telephone, fax, and computer services.

The State will provide conference facilities for DRA meetings at no cost to the Contractor.

The Contractor shall make direct payments to the DRA for participation in authorized meetings and approved hourly rate charges from invoices submitted.

The State will reimburse the Contractor for the State's share of the costs.

There will be no markups applied to expenses associated with the DRA, either by the DRA or by the Contractor when requesting payment of the State's share of DRA expenses. Regardless of the DRA recommendation, neither party will be entitled to reimbursement of DRA costs from the other party.

The Contractor shall submit extra work bills and include invoices with original supporting documents for reimbursement of the State's share.

The cost of technical services will be borne equally by the State and Contractor. There will be no markups for these costs.

A copy of the "Dispute Resolution Advisor Agreement" to be executed by the Contractor, State and the DRA is as follows:



## DISPUTE RESOLUTION ADVISOR AGREEMENT

\_\_\_\_\_  
(Contract Identification)

Contract No. \_\_\_\_\_

**THIS DISPUTE RESOLUTION ADVISOR AGREEMENT, hereinafter called "AGREEMENT"**, made and entered into this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_, between the State of California, acting through the California Department of Transportation and the Director of Transportation, hereinafter called the "STATE," \_\_\_\_\_ hereinafter called the "CONTRACTOR," and \_\_\_\_\_, the Dispute Resolution Advisor, hereinafter called the "DRA."

WITNESSETH, that

WHEREAS, the STATE and the CONTRACTOR, hereinafter called the "parties," are now engaged in the construction on the State Highway project referenced above; and

WHEREAS, the Standard Specifications for the above referenced contract provides for the establishment and operation of the DRA to assist in resolving disputes; and

WHEREAS, the DRA is composed of one person, chosen by the CONTRACTOR and the STATE;

NOW THEREFORE, in consideration of the terms, conditions, covenants, and performance contained herein, or attached and incorporated and made a part hereof, the STATE, the CONTRACTOR, and the DRA hereto agree as follows:

### SECTION I DESCRIPTION OF WORK

To assist in the timely resolution of disputes between the parties, the contract provides for the establishment and the operation of the DRA. The DRA is to fairly and impartially consider disputes placed before it and provide recommendations for resolution of these disputes to the parties. The DRA shall provide recommendations based on the facts related to the dispute, the contract and applicable laws and regulations. The DRA shall perform the services necessary to participate in the DRA's actions as designated in Section III, Scope of Work.

### SECTION II DRA QUALIFICATIONS

The DRA shall be knowledgeable in the type of construction and contract documents anticipated by the contract and shall have completed training through the Dispute Review Board Foundation. In addition, it is desirable for the DRA to have served on several State Dispute Resolution Boards (DRB).

No DRA shall have prior direct involvement in this contract. No DRA shall have a financial interest in this contract or parties thereto, including but not limited to the CONTRACTOR, subcontractors, suppliers, consultants, and legal and business services, within a period 6 months prior to award and during this contract. Exceptions to above are compensation for services on this or other DRAs and DRBs or retirement payments or pensions received from a party that are not tied to, dependent on or affected by the net worth of the party.

The DRA shall fully disclose all direct or indirect professional or personal relationships with all key members of the contract.

### SECTION III SCOPE OF WORK

The Scope of Work of the DRA includes, but is not limited to, the following:

#### A. PROCEDURES

The DRA shall meet with the parties at the start of the project to establish procedures that will govern the conduct of its business and reporting procedures in conformance with the requirements of the contract and the terms of this AGREEMENT. The DRA established procedures shall only be implemented upon approval by the parties. Subsequent meetings shall be held only to hear disputes between the parties.

The DRA shall not meet with, or discuss contract issues with individual parties.

The State shall provide the DRA with the contract and all written correspondence regarding the dispute between the parties and, if available, the Contractor's supplemental potential claim record, and the Engineer's response to the supplemental potential claim record.

The parties shall not call the DRA who served on this contract as a witness in arbitration proceedings, which may arise from this contract.

The DRA shall have no claim against the STATE or the CONTRACTOR, or both, from claimed harm arising out of the parties' evaluations of the DRA's opinions.

## **B. DISPUTE MEETING**

The term "dispute meeting" as used in this subsection shall refer to both the informal and traditional dispute meeting processes, unless otherwise noted.

If the CONTRACTOR requests a dispute meeting with the DRA, the Contractor must simultaneously notify the STATE. Upon being notified of the need for a dispute meeting, the DRA shall review and consider the dispute. The DRA shall determine the time and location of the dispute meeting with due consideration for the needs and preferences of the parties, while recognizing the importance of a speedy resolution to the dispute.

Dispute meetings shall be conducted at any location that would be convenient and provide required facilities and access to necessary documentation.

Only the STATE's Area Construction Engineer, Resident Engineer, and Structure Representative and the CONTRACTOR's or subcontractor's, Superintendent or Project Manager may present information at a dispute meeting. There shall be no participation of persons who are not directly involved in the contract or who do not have direct knowledge of the dispute. The exception to this is technical services, as described below:

The DRA, with approval of the parties, may obtain technical services necessary to adequately review the disputes presented, including audit, geotechnical, schedule analysis and other services. The parties' technical staff may supply those services as appropriate. The cost of technical services, as agreed to by the parties, shall be borne equally by the two parties as specified in an approved contract change order. The CONTRACTOR shall not be entitled to markups for the payments made for these services.

At the dispute meeting the DRA may ask questions, seek clarification, and request further clarification of data presented by either of the parties as may be necessary to assist in making a fully informed recommendation. However, the DRA shall refrain from expressing opinions on the merits of statements on matters under dispute during the parties' presentations. Each party will be given ample time to fully present its position, make rebuttals, provide relevant documents, and respond to DRA questions and requests.

There shall be no testimony under oath or cross-examination, during DRA dispute meetings. There shall be no reporting of the procedures by a shorthand reporter or by electronic means. Documents and verbal statements shall be received by the DRA in conformance with the rules and regulations established at the first meeting between the DRA and parties. These established rules and regulations need not comply with prescribed legal laws of evidence.

Failure to attend a dispute meeting by either of the parties shall be conclusively considered by the DRA as indication that the non-attending party considers all written documents and correspondence submitted as their entire and complete argument. The claimant shall discuss the dispute, followed by the other party. Each party shall then be allowed one or more rebuttals at the meeting until all aspects of the dispute are thoroughly covered.

### **1. TRADITIONAL DISPUTE MEETING:**

The following procedure shall be used for the traditional dispute meeting:

- a. Within 5 days after receiving the STATE's written response to the CONTRACTOR's supplemental potential claim record, the CONTRACTOR shall refer the dispute to the DRA, if the CONTRACTOR wishes to further pursue the dispute. The CONTRACTOR shall make the referral in writing to the DRA, simultaneously copied to the STATE. The written dispute referral shall describe the disputed matter in individual discrete segments, so that it will be clear to both parties and the DRA what discrete elements of the dispute have been resolved, and which remain unresolved, and shall include an estimate of the cost of the affected work and impacts, if any, on project completion.
- b. The parties shall each be afforded an opportunity to be present and to be heard by the DRA, and to offer evidence. Either party furnishing written evidence or documentation to the DRA must furnish copies of such information to the other party a minimum of 10 days prior to the date the DRA is scheduled to convene the meeting for the dispute. Either party shall produce such additional evidence as the DRA may deem necessary to reach an understanding and a determination of the dispute. The party furnishing additional evidence shall furnish copies of such additional evidence to the other party

at the same time the evidence is provided to the DRA. The DRA shall not consider evidence not furnished in conformance with the terms specified herein.

- c. Upon receipt by the DRA of a written referral of a dispute, the DRA shall convene to review and consider the dispute. The dispute meeting shall be held no later than 25 days after receipt of the written referral unless otherwise agreed to by all parties.
- d. The DRA shall furnish a written report to both parties. The DRA may request clarifying information of either party within 5 days after the DRA dispute meeting. Requested information shall be submitted to the DRA within 5 days of the DRA request. The DRA shall complete its report and submit it to the parties within 10 days of the DRA dispute meeting, except that time extensions may be granted at the request of the DRA with the written concurrence of both parties. The report shall summarize the facts considered, the contract language, law or regulation viewed by the DRA as pertinent to the dispute, and the DRA's interpretation and philosophy in arriving at its conclusions and recommendations and, if appropriate, recommends guidelines for determining compensation. The DRA's written opinion shall stand on its own, without attachments or appendices.
- e. Within 10 days after receiving the DRA's report, both parties shall respond to the DRA in writing signifying that the dispute is either resolved or remains unresolved. Failure to provide the written response within the time specified, or a written rejection of the DRA's recommendation or response to a request for reconsideration presented in the report by either party, shall conclusively indicate that the party(s) failing to respond accepts the DRA recommendation. Immediately after responses have been received from both parties, the DRA shall provide copies of both responses to the parties simultaneously. Either party may request clarification of elements of the DRA's report from the DRA prior to responding to the report. The DRA shall consider any clarification request only if submitted within 5 days of receipt of the DRA's report, and if submitted simultaneously in writing to both the DRA and the other party. Each party may submit only one request for clarification for any individual DRA report. The DRA shall respond, in writing, to requests for clarification within 5 days of receipt of such requests.
- f. Either party may seek a reconsideration of the DRA's recommendation. The DRA shall only grant reconsideration based upon submission of new evidence and if the request is submitted within the 10 day time limit specified for response to the DRA's written report. Each party may submit only one request for reconsideration regarding an individual DRA recommendation.
- g. If the parties are able to settle their dispute with the aid of the DRA's report, the STATE and CONTRACTOR shall promptly accept and implement the settlement of the parties. If the parties cannot agree on compensation within 30 days of the acceptance by both parties of the settlement, either party may request the DRA to make a recommendation regarding compensation.

## **2. INFORMAL DISPUTE MEETING**

An informal dispute meeting shall be convened, only if, the parties and the DRA agree that this dispute resolution process is appropriate to settle the dispute.

The following procedure shall be used for the informal dispute meeting:

- a. The parties shall furnish the DRA with one copy of pertinent documents requested by the DRA that are or may become necessary for the DRA to perform its function. The party furnishing documents shall furnish such documents to the other party at the same time the document is provided to the DRA.
- b. After the dispute meeting has concluded, the DRA shall deliberate in private the same day, until a response to the parties is reached or as otherwise agreed to by the parties.
- c. The DRA then verbally delivers its recommendation with findings to the parties.
- d. After the recommendation is presented, the parties may ask for clarifications.
- e. Occasionally the DRA, on complex issues, may be unable to formulate a recommendation based on the information given at a dispute meeting. However, the DRA may provide the parties with advice on strengths and weaknesses of their prospective positions, in the hope of the parties reaching settlement.
- f. If the parties are able to settle their dispute with the aid of the DRA's opinion, the STATE and CONTRACTOR shall promptly accept and implement the settlement of the parties.
- g. The DRA will not be bound by its oral recommendation in the event that a dispute is later heard by the DRA in a traditional dispute meeting.

Unless the dispute is settled, use of the informal dispute meeting does not relieve the parties of their responsibilities under Section 5-1.15B, "Dispute Resolution Advisor," of the Standard Specifications or Subsection, "Traditional Dispute Meeting," of this AGREEMENT. There will be no extension of time allowed for the process to permit the use of the informal dispute meeting, unless otherwise agreed to by the parties.

#### **SECTION IV TIME FOR BEGINNING AND COMPLETION**

Once established, the DRA shall be in operation until the day the Director accepts the contract. The DRA shall not begin work under the terms of this AGREEMENT until authorized in writing by the STATE or as agreed to by the parties.

#### **SECTION V PAYMENT**

The DRA shall be compensated at an agreed rate of \$1,500 per day for time spent per meeting, either at the start of the project or for a dispute. A member serving on more than one State DRA or DRB, regardless the number of meetings per day, shall not be paid more than the agreed rate per day. The agreed rate shall be considered full compensation for onsite time, travel expenses, transportation, lodging, time for travel and incidentals for each day, or portion thereof that the DRA is at an authorized DRA meeting. No additional compensation will be made for time spent by the DRA to review and research activities outside the official DRA meetings unless that time, (such as time spent evaluating and preparing recommendations on specific issues presented to the DRA), has been specifically agreed to in advance by the parties. Time away from the project, which has been specifically agreed to in advance by the parties, will be compensated at an agreed rate of \$150 per hour. The agreed amount of \$150 per hour shall include all incidentals including expenses for telephone, fax, and computer services. The State will provide administrative services such as conference facilities to the DRA.

##### **A. PAYMENT PROCESSING**

The CONTRACTOR shall make direct payments to the DRA for their participation in authorized meetings and approved hourly rate charges, from invoices submitted by the DRA, and technical services.

The DRA may submit invoices to the CONTRACTOR for partial payment for work performed and services rendered for their participation in authorized meetings not more often than once per month during the progress of the work. The invoices shall be in a format approved by the parties and accompanied by a general description of activities performed during that billing period. Payment for hourly fees, at the agreed rate, shall not be paid to the DRA until the amount and extent of those fees are approved by the STATE and CONTRACTOR.

##### **B. INSPECTION OF COSTS RECORDS**

The DRA and the CONTRACTOR shall keep available for inspection by representatives of the STATE and the United States, for a period of 3 years after final payment, the cost records and accounts pertaining to this AGREEMENT. If any litigation, claim, or audit arising out of, in connection with, or related to this contract is initiated before the expiration of the 3-year period, the cost records and accounts shall be retained until such litigation, claim, or audit involving the records is completed.

#### **SECTION VI ASSIGNMENT OF TASKS OF WORK**

The DRA shall not assign the work of this AGREEMENT.

#### **SECTION VII TERMINATION OF DRA**

The DRA may resign after providing not less than 15 days written notice of the resignation to the STATE and CONTRACTOR. The DRA may be terminated, by either party, for failing to fully comply at all times with all required employment or financial disclosure conditions of DRA membership in conformance with the terms of the contract and this AGREEMENT. Each party shall document the need for replacement and substantiate the replacement request in writing to the other party and the DRA.

#### **SECTION VIII LEGAL RELATIONS**

The parties hereto mutually understand and agree that the DRA in the performance of duties is acting in the capacity of an independent agent and not as an employee of either party.

No party to this AGREEMENT shall bear a greater responsibility for damages or personal injury than is normally provided by Federal or State of California Law.

Notwithstanding the provisions of this contract that require the CONTRACTOR to indemnify and hold harmless the STATE, the parties shall jointly indemnify and hold harmless the DRA from and against all claims, damages, losses, and expenses, including but not limited to attorney's fees, arising out of and resulting from the findings and recommendations of the DRA.

## **SECTION IX CONFIDENTIALITY**

The parties hereto mutually understand and agree that all documents and records provided by the parties in reference to issues brought before the DRA, which documents and records are marked "Confidential - for use by the DRA only," shall be kept in confidence and used only for the purpose of resolution of subject disputes, and for assisting in development of DRA findings and recommendations; that such documents and records will not be utilized or revealed to others, except to officials of the parties who are authorized to act on the subject disputes, for any purposes, during the life of this AGREEMENT. Upon termination of this AGREEMENT, said confidential documents and records, and all copies thereof, shall be returned to the parties who furnished them to the DRA. However, the parties understand that such documents may be subsequently discoverable and admissible in court or arbitration proceedings unless a protective order has been obtained by the party seeking further confidentiality.

## **SECTION X DISPUTES**

Disputes between the parties arising out of the work or other terms of this AGREEMENT that cannot be resolved by negotiation and mutual concurrence between the parties or through the administrative process provided in the contract shall be resolved by arbitration as provided in Section 9-1.10, "Arbitration," of the Standard Specifications. Disputes between the DRA and the parties that cannot be resolved by negotiation and mutual concurrence shall be resolved in the appropriate forum.

## **SECTION XI VENUE, APPLICABLE LAW, AND PERSONAL JURISDICTION**

In the event that any party, including the DRA, deems it necessary to institute arbitration proceedings to enforce any right or obligation under this AGREEMENT, the parties hereto agree that such action shall be initiated in the Office of Administrative Hearings of the State of California. The parties hereto agree that all questions shall be resolved by arbitration by application of California law and that the parties to such arbitration shall have the right of appeal from such decisions to the Superior Court in conformance with the laws of the State of California. Venue for the arbitration shall be Sacramento or any other location as agreed to by the parties.

## **SECTION XII FEDERAL REVIEW AND REQUIREMENTS**

On Federal-Aid contracts, the Federal Highway Administration shall have the right to review the work of the DRA in progress, except for private meetings or deliberations of the DRA.

Other Federal requirements in this agreement shall only apply to Federal-Aid contracts.

## **SECTION XIII CERTIFICATION OF CONTRACTOR, DRA, AND STATE**

IN WITNESS WHEREOF, the parties hereto have executed this AGREEMENT as of the day and year first above written.

DRA

By: \_\_\_\_\_

Title: \_\_\_\_\_

CONTRACTOR

CALIFORNIA DEPARTMENT  
OF TRANSPORTATION

By: \_\_\_\_\_

By: \_\_\_\_\_

Title: \_\_\_\_\_

Title: \_\_\_\_\_

### **5-1.15C Dispute Resolution Board**

Section 5-1.15C, "Dispute Resolution Board," applies to a contract with a total bid of over \$10 million.

The Dispute Resolution Board, hereinafter referred to as "DRB," is a three member board established by the Department and Contractor to assist in the resolution of disputes.

The DRB shall be established by the Department and the Contractor within 45 days after contract approval.

The DRB shall consist of one member selected by the Department and approved by the Contractor, one member selected by the Contractor and approved by the Department, and a third member selected by the first 2 members and approved by both the Department and the Contractor.

The Department and Contractor shall provide the other written notification for approval of the name of their DRB nominee along with the nominee's disclosure statement.

Disclosure statements shall include a resume of the nominee's experience and a declaration statement describing past, present, anticipated, and planned relationships with all parties involved in this contract. Objections to nominees shall be based on a specific breach or violation of nominee responsibilities or on nominee qualifications. The Department or the Contractor may, on a one-time basis, object to the other's nominee without specifying a reason and this person shall not be selected for the DRB. Another person shall then be nominated within 15 days.

The 2 DRB members shall proceed with the selection of the third DRB member immediately after receiving written notification from the Department of their selection. The 2 DRB members shall provide their recommendation simultaneously to the parties within 15 days. The third member shall provide disclosure statement to the first 2 DRB members, to the Department, and the Contractor. The professional experience of the third DRB member shall complement that of the first 2 DRB members. The third DRB member shall be subject to mutual approval of the Department and the Contractor. If the 2 DRB members cannot agree on the third nominee, they shall submit a list of nominees to the Department and the Contractor for final selection and approval.

If the Department and the Contractor cannot agree on the third DRB member, or if the first 2 DRB members are unable to agree upon a recommendation, the Department and the Contractor shall select 6 names from the current list of arbitrators certified by the Public Works Contract Arbitration Committee created by Article 7.2 of the State Contract Act. The 2 DRB members shall then select one of the 6 names by a blind draw.

The 3 DRB members shall appoint one member as a chairperson to provide leadership for the DRB's activities. The chairperson shall be approved by the Department and the Contractor. In the event of an impasse, the third DRB member shall become the chairperson.

The Department and Contractor shall complete and adhere to the Dispute Resolution Board Agreement. No DRB meeting shall take place until the Dispute Resolution Board Agreement has been signed by all parties, unless all parties agree to sign it at the first meeting.

If the DRB needs outside technical services, technical services shall be preapproved by both the Department and the Contractor.

DRB recommendations are nonbinding.

The Contractor shall not use the DRB for disputes between the subcontractors or suppliers that have no grounds for a lawsuit against the Department.

DRB member replacements are selected in the same manner as the original selection. The appointment of a replacement DRB member will begin promptly upon determination of the need for replacement. The Dispute Resolution Board Agreement shall be amended to reflect the change in the DRB.

Failure of the Contractor to participate in establishing the DRB will result in the withholding of 25 percent of the estimated value of all work performed during each estimate period that the Contractor fails to comply. DRB withholds will be released for payment on the next monthly progress payment following the date that the Contractor has provided assistance in establishing the DRB and no interest will be due the Contractor.

The Department and the Contractor shall bear the costs and expenses of the DRB equally.

Each DRB member shall be compensated at an agreed rate of \$1,500 per day for time spent per meeting either at the start of the project, for scheduled progress, or dispute meetings. A member serving on more than one Department DRB or Dispute Resolution Advisor (DRA), regardless of the number of meetings per day shall not be paid more than the agreed rate per day. The agreed rate shall be considered full compensation for on-site time, travel expenses, transportation, lodging, time for travel, and incidentals for each day or portion thereof that the DRB member is at an authorized DRB meeting.

No additional compensation will be made for time spent by DRB members in review and research activities outside the official DRB meetings unless that time, such as time spent evaluating and preparing recommendations on specific issues presented to the DRB, has been specifically agreed to in advance by the Department and Contractor. Time away from the project, which has been specifically agreed to in advance by the Department and Contractor, will be compensated at an agreed rate of \$150 per hour. The agreed amount of \$150 per hour shall include all incidentals including expenses for telephone, fax, and computer services.

The Department will provide conference facilities for DRB meetings at no cost to the Contractor.

The Contractor shall make direct payments to each DRB member for their participation in authorized meetings and approved hourly rate charges from invoices submitted by each DRB member.

The Department will reimburse the Contractor for the Department's share of the costs.

There will be no markups applied to expenses connected with the DRB, either by the DRB members or by the Contractor when requesting payment of the Department's share of DRB expenses. Regardless of the DRB recommendation, neither party shall be entitled to reimbursement of DRB costs from the other party.

The Contractor shall submit extra work bills and include evidence of every payment to each DRB member in the form of a cancelled check or bank statement within 30 days of payment.

The cost of technical services requested by the DRB will be borne equally by the State and Contractor. There will be no markups for these costs.

A copy of the "Dispute Resolution Board Agreement" to be executed by the Department, Contractor, and the 3 DRB members after approval of the contract follows:

## DISPUTE RESOLUTION BOARD AGREEMENT

\_\_\_\_\_  
(Contract Identification)

Contract No. \_\_\_\_\_

**THIS DISPUTE RESOLUTION BOARD AGREEMENT, hereinafter called "AGREEMENT"**, made and entered into this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_, between the State of California, acting through the California Department of Transportation and the Director of Transportation, hereinafter called the "STATE," \_\_\_\_\_ hereinafter called the "CONTRACTOR," and the Dispute Resolution Board, hereinafter called the "DRB" consisting of the following members:

\_\_\_\_\_,  
(DRB Member)

\_\_\_\_\_,  
(DRB Member)

and \_\_\_\_\_  
(DRB Chairperson)

WITNESSETH, that

WHEREAS, the STATE and the CONTRACTOR, hereinafter called the "parties," are now engaged in the construction on the State Highway project referenced above; and

WHEREAS, the Standard Specifications for the above referenced contract provides for the establishment and operation of the DRB to assist in resolving disputes; and

WHEREAS, the DRB is composed of three members, one selected by the STATE, one selected by the CONTRACTOR, and the third member selected by the other two members and approved by the parties; and

NOW THEREFORE, in consideration of the terms, conditions, covenants, and performance contained herein, or attached and incorporated and made a part hereof, the STATE, the CONTRACTOR, and the DRB members hereto agree as follows:

### SECTION I DESCRIPTION OF WORK

To assist in the timely resolution of disputes between the parties, the contract provides for the establishment and the operation of the DRB. The DRB is to fairly and impartially consider disputes placed before it and provide recommendations for resolution of these disputes to the parties. The DRB shall provide recommendations based on the facts related to the dispute, the contract and applicable laws and regulations. The DRB shall perform the services necessary to participate in the DRB's actions as designated in Section III, Scope of Work.

### SECTION II DRB QUALIFICATIONS

DRB members shall be knowledgeable in the type of construction and contract documents anticipated by the contract and shall have completed training through the Dispute Review Board Foundation.

No DRB member shall have prior direct involvement in this contract. No DRB member shall have a financial interest in this contract or parties thereto, including but not limited to the CONTRACTOR, subcontractors, suppliers, consultants, and legal and business services, within a period 6 months prior to award and during this contract. Exceptions to above are compensation for services on this or other DRBs and DRAs or retirement payments or pensions received from a party that are not tied to, dependent on or affected by the net worth of the party.

DRB members shall fully disclose all direct or indirect professional or personal relationships with all key members of the contract.



### **SECTION III SCOPE OF WORK**

The scope of work of the DRB includes, but is not limited to, the following:

#### **A. PROCEDURES**

The DRB shall establish procedures that will govern the conduct of its business and reporting procedures in conformance with the requirements of the contract and the terms of this AGREEMENT. The DRB established procedures shall only be implemented upon approval of the parties.

The DRB Chairperson shall schedule progress and dispute meetings and any other DRB activities.

The parties shall not call on any of the DRB members, who served on this contract, as a witness in arbitration proceedings, which may arise from this contract.

DRB members shall have no claim against the STATE or the CONTRACTOR, or both, from claimed harm arising out of the parties' evaluations of the DRB's opinions.

During progress or dispute meetings, DRB members shall refrain from expressing opinions on the merits of statements on matters under dispute or potential dispute. Opinions of DRB members expressed in private sessions shall be kept strictly confidential. Individual DRB members shall not meet with, or discuss contract issues with individual parties. Discussions regarding the project between the DRB members and the parties shall be in the presence of all three members and both parties. Individual DRB members shall not undertake independent investigations of any kind pertaining to disputes or potential disputes, except with the knowledge of both parties and as expressly directed by the DRB Chairperson.

#### **B. PROGRESS MEETINGS**

DRB members shall visit the project site and meet with representatives of the parties to keep abreast of construction activities and to develop familiarity with the work in progress. Scheduled progress meetings shall be held at or near the project site. The DRB shall meet at least once at the start of the project, and at least once every 4 months thereafter. The frequency, exact time, and duration of additional site visits and progress meetings shall be as recommended by the DRB and approved by the parties consistent with the construction activities or matters under consideration and dispute. Scheduled progress meetings may be waived, if the parties are in agreement, when the only work remaining is plant establishment work. Each meeting shall consist of a round table discussion and a field inspection of the work being performed on the contract, if necessary. Each meeting shall be attended by representatives of both parties. The agenda shall generally be as follows:

1. Meeting opened by the DRB Chairperson.
2. Remarks by the STATE's representative.
3. A description by the CONTRACTOR's representative of work accomplished since the last meeting; the current schedule status of the work; and a forecast for the coming period.
4. An outline by the STATE's representative of the status of the work as the STATE views it.
5. An outline by the CONTRACTOR's representative of potential problems and a description of proposed solutions.
6. A brief description by the CONTRACTOR's and the STATE's representative of potential claims and disputes that have surfaced since the last meeting.
7. A summary by the STATE's representative, the CONTRACTOR's representative, or the DRB of the status of past potential claims and disputes.

The STATE's representative will prepare minutes of all progress meetings and circulate them for revision and approval by all concerned within 10 days of the meeting.

#### **C. DISPUTE MEETING**

The term "dispute meeting" as used in this subsection shall refer to both the informal and traditional dispute meeting processes, unless otherwise noted.

Either the STATE or the CONTRACTOR may request a dispute meeting with the DRB. The requesting party shall simultaneously notify the other party of each dispute meeting request. Upon being notified of the need for a dispute meeting, the DRB shall review and consider the dispute. The DRB shall determine the time and location of the dispute meeting with due consideration for the needs and preferences of the parties, while recognizing the importance of a speedy resolution to the dispute.

Dispute meetings shall be conducted at any location that would be convenient and provide required facilities and access to necessary documentation.

No DRB dispute meeting shall take place later than 30 days prior to acceptance of the contract.

Only the STATE's Area Construction Engineer, Resident Engineer, and Structure Representative and the CONTRACTOR's or subcontractor's, Superintendent or Project Manager may present information at a dispute meeting. There shall be no participation of persons who are not directly involved in the contract or who do not have direct knowledge of the dispute. The exception to this is technical services, as described below:

The DRB, with approval of the parties, may obtain technical services necessary to adequately review the disputes presented, including audit, geotechnical, schedule analysis and other services. The parties' technical staff may supply those services as appropriate. The cost of technical services, as agreed to by the parties, shall be borne equally by the two parties as specified in an approved contract change order. The CONTRACTOR shall not be entitled to markups for the payments made for these services.

At the dispute meeting the DRB may ask questions, seek clarification, and request further clarification of data presented by either of the parties as may be necessary to assist in making a fully informed recommendation. However, the DRB shall refrain from expressing opinions on the merits of statements on matters under dispute during the parties' presentations. The claimant shall discuss the dispute, followed by the other party. Each party shall then be allowed one or more rebuttals at the meeting until all aspects of the dispute are thoroughly covered. Each party will be given ample time to fully present its position, make rebuttals, provide relevant documents, and respond to DRB questions and requests.

There shall be no testimony under oath or cross-examination, during DRB dispute meetings. There shall be no reporting of the procedures by a shorthand reporter or by electronic means. Documents and verbal statements shall be received by the DRB in conformance with the procedures established at the first meeting between the DRB and the parties. These established procedures need not comply with prescribed legal laws of evidence.

Failure to attend a dispute meeting by either of the parties shall be conclusively considered by the DRB as indication that the non-attending party considers all written documents and correspondence submitted as their entire and complete argument.

After dispute meetings are concluded, the DRB shall meet in private and reach a conclusion supported by two or more members. Private sessions of the DRB may be held at a location other than the job site or by electronic conferencing as deemed appropriate, in order to expedite the process.

The DRB shall make every effort to reach a unanimous decision.

#### **1. TRADITIONAL DISPUTE MEETING:**

The following procedure shall be used for the traditional dispute meeting:

- a. Within 21 days after receiving the STATE's written response to the CONTRACTOR's supplemental potential claim record, the CONTRACTOR shall refer the dispute to the DRB if the CONTRACTOR wishes to further pursue the dispute. The CONTRACTOR shall make the referral in writing to the DRB, simultaneously copied to the STATE. The written dispute referral shall describe the disputed matter in individual discrete segments, so that it will be clear to both parties and the DRB what discrete elements of the dispute have been resolved, and which remain unresolved, and shall include an estimate of the cost of the affected work and impacts, if any, on project completion.
- b. The parties shall each be afforded an opportunity to be present and to be heard by the DRB, and to offer evidence. Either party furnishing written evidence or documentation to the DRB must furnish copies of such information to the other party a minimum of 15 days prior to the date the DRB is scheduled to convene the meeting for the dispute. Either party shall produce such additional evidence as the DRB may deem necessary to reach an understanding and a determination of the dispute. The party furnishing additional evidence shall furnish copies of such additional evidence to the other party at the same time the evidence is provided to the DRB. The DRB shall not consider evidence not furnished in conformance with the terms specified herein.
- c. Upon receipt by the DRB of a written referral of a dispute, the DRB shall convene to review and consider the dispute. The dispute meeting shall be held no earlier than 30 days and no later than 60 days after receipt of the written referral unless otherwise agreed to by all parties.
- d. The DRB may request clarifying information of either party within 10 days after the dispute meeting. Requested information shall be submitted to the DRB within 10 days of the DRB request.
- e. The DRB shall furnish a written report to the parties with its conclusion(s) and recommendation(s). The DRB shall complete its report, including minority opinion, if any, and submit it to the parties within 30 days of the dispute meeting, except that time extensions may be granted at the request of the DRB with the written concurrence of the parties. The report shall summarize the facts considered, the contract language, law or regulation viewed by the DRB as pertinent to the dispute, and the DRB's interpretation and reasoning in arriving at its conclusion(s) and recommendation(s) and, if appropriate, recommends

guidelines for determining compensation. The DRB's written opinion shall stand on its own, without attachments or appendices. The DRB Chairperson shall furnish a copy of the written recommendation report to the DRB Coordinator, Division of Construction, MS 44, P.O. Box 942874, Sacramento, CA 94274.

- f. Within 30 days after receiving the DRB's report, the parties shall respond to the DRB in writing signifying that the dispute is either resolved or remains unresolved. Failure to provide the written response within the time specified, or a written rejection of the DRB's recommendation or a written response requesting the DRB reconsider their recommendation, shall conclusively indicate that the party(s) failing to respond accepts the DRB recommendation. Immediately after responses have been received from both parties, the DRB shall provide copies of both responses to the parties simultaneously. Either party may request clarification of elements of the DRB's report from the DRB prior to responding to the report. The DRB shall consider any clarification request only if submitted within 10 days of receipt of the DRB's report, and if submitted simultaneously in writing to both the DRB and the other party. Each party may submit only one request for clarification for any individual DRB report. The DRB shall respond, in writing, to requests for clarification within 10 days of receipt of such requests.
- g. Either party may seek a reconsideration of the DRB's recommendation. The DRB shall only grant reconsideration based upon submission of new evidence and if the request is submitted within the 30 day time limit specified for response to the DRB's written report. Each party may submit only one request for reconsideration regarding an individual DRB recommendation.
- h. If the parties are able to settle their dispute with the aid of the DRB's report, the STATE and the CONTRACTOR shall promptly accept and implement the settlement of the parties. If the parties cannot agree on compensation within 60 days of the acceptance by both parties of the settlement, either party may request the DRB to make a recommendation regarding compensation.

## **2. INFORMAL DISPUTE MEETING**

An informal dispute meeting shall be convened, only if, the parties and the DRB agree that this dispute resolution process is appropriate to settle the dispute.

The following procedure shall be used for the informal dispute meeting:

- a. The parties shall furnish the DRB with one copy of pertinent documents requested by the DRB that are or may become necessary for the DRB to perform its function. The party furnishing documents shall furnish such documents to the other party at the same time the document is provided to the DRB.
- b. After the dispute meeting has concluded, the DRB members shall deliberate in private the same day until a response to the parties is reached or as otherwise agreed to by the parties.
- c. The DRB then verbally delivers its recommendation with findings, including minority opinion, if any, to the parties.
- d. After the recommendation is presented, the parties may ask for clarifications.
- e. Occasionally the DRB may be unable to formulate a recommendation based on the information given at a dispute meeting. However, the DRB may provide the parties with advice on strengths and weaknesses of their prospective positions, in the hope of the parties reaching settlement.
- f. If the parties are able to settle their dispute with the aid of the DRB's opinion, the STATE and the CONTRACTOR shall promptly accept and implement the settlement of the parties.
- g. The DRB will not be bound by its verbal recommendation in the event that a dispute is later heard by the DRB in a traditional dispute meeting.

Unless the dispute is settled, use of the informal dispute meeting does not relieve the parties of their responsibilities under Section 5-1.15C, "Dispute Resolution Board," of the Standard Specifications or subsection, "Traditional Dispute Meeting," of this AGREEMENT. There will be no extension of time allowed for the process to permit the use of the informal dispute meeting, unless otherwise agreed to by the parties.

## **SECTION IV TIME FOR BEGINNING AND COMPLETION**

DRB members shall not begin work under the terms of this AGREEMENT, until authorized in writing by the STATE or as agreed to by the parties. Once established, the DRB shall be in operation until the Director accepts the contract. If the contract is terminated in accordance with Section 8-1.08, "Termination of Control," of the Standard Specifications, the DRB will be dissolved.

## **SECTION V PAYMENT**

Each DRB member shall be compensated at an agreed rate of \$1,500 per day for time spent per meeting, either at start of project, or a scheduled progress or a dispute meeting. A member serving on more than one State DRB or DRA, regardless of the number of meetings per day, shall not be paid more than the agreed rate per day. The agreed rate shall be considered full compensation for on site time, travel expenses, transportation, lodging, time for travel and incidentals for each day, or portion thereof that the DRB member is at an authorized DRB meeting. No additional compensation will be made for time spent by DRB member to review and research activities outside the official DRB meetings unless that time, such as time spent evaluating and preparing recommendations on specific issues presented to the DRB, has been specifically agreed to in advance by the parties. Time away from the project, which has been specifically agreed to in advance by the parties, will be compensated at an agreed rate of \$150 per hour. The agreed amount of \$150 per hour shall include all incidentals including expenses for telephone, fax, and computer services. The State will provide administrative services such as conference facilities to the DRB.

### **A. PAYMENT PROCESSING**

The CONTRACTOR shall make direct payments to each DRB member for their participation in authorized meetings and approved hourly rate charges, from invoices submitted by each DRB member, and technical services.

DRB members may submit invoices to the CONTRACTOR for partial payment for work performed and services rendered for their participation in authorized meetings not more often than once per month during the progress of the work. The invoices shall be in a format approved by the parties and accompanied by a general description of activities performed during that billing period. Payment for hourly fees, at the agreed rate, shall not be paid to a DRB member until the amount and extent of those fees are approved by the STATE and the CONTRACTOR.

### **B. INSPECTION OF COSTS RECORDS**

DRB members and the CONTRACTOR shall keep available for inspection by representatives of the STATE and the United States federal government, for a period of 3 years after final payment, the cost records and accounts pertaining to this AGREEMENT. If any litigation, claim, or audit arising out of, in connection with, or related to this contract is initiated before the expiration of the 3-year period, the cost records and accounts shall be retained until such litigation, claim, or audit involving the records is completed.

## **SECTION VI ASSIGNMENT OF TASKS OF WORK**

DRB members shall not assign the work of this AGREEMENT.

## **SECTION VII TERMINATION OF A DRB MEMBER**

DRB members may resign after providing not less than 15 days written notice of their resignation to the STATE and the CONTRACTOR. A DRB member may be terminated, by either party, for failing to comply at all times with all required employment or financial disclosure conditions of DRB membership in conformance with the terms of the contract and this AGREEMENT.

Service of a DRB member may be terminated at any time with not less than 15 days notice as follows:

- A. The State may terminate service of the State appointed member.
- B. The Contractor may terminate service of the Contractor appointed member.
- C. Upon the written recommendation of the State and Contractor appointed members for the removal of the third member.
- D. Upon resignation of a member.

When a member of the DRB is replaced, the replacement member shall be appointed in the same manner as the replaced member was appointed. The appointment of a replacement DRB member will begin promptly upon determination of the need for replacement and shall be completed within 15 days. Changes in either of the DRB members chosen by the 2 parties will not require re-selection of the third member, unless both parties agree to such re-selection in writing. The Dispute Resolution Board Agreement shall be amended to reflect the change of a DRB member.

Each party shall document the need for replacement and substantiate the replacement request in writing to the other party and DRB members.

## **SECTION VIII LEGAL RELATIONS**

The parties hereto mutually understand and agree that each DRB member in the performance of duties is acting in the capacity of an independent agent and not as an employee of either party.

No party to this AGREEMENT shall bear a greater responsibility for damages or personal injury than is normally provided by Federal or State of California Law.

Notwithstanding the provisions of this contract that require the CONTRACTOR to indemnify and hold harmless the STATE, the parties shall jointly indemnify and hold harmless the DRB members from and against all claims, damages, losses, and expenses, including but not limited to attorney's fees, arising out of and resulting from the findings and recommendations of the DRB.

## **SECTION IX CONFIDENTIALITY**

The parties hereto mutually understand and agree that all documents and records provided by the parties in reference to issues brought before the DRB, which documents and records are marked "Confidential - for use by the DRB only," shall be kept in confidence and used only for the purpose of resolution of subject disputes, and for assisting in development of DRB findings and recommendations; that such documents and records will not be utilized or revealed to others, except to officials of the parties who are authorized to act on the subject disputes, for any purposes, during the life of this AGREEMENT. Upon termination of this AGREEMENT, said confidential documents and records, and all copies thereof, shall be returned to the parties who furnished them to the DRB. However, the parties understand that such documents may be subsequently discoverable and admissible in court or arbitration proceedings unless a protective order has been obtained by the party seeking further confidentiality.

## **SECTION X DISPUTES**

Disputes between the parties arising out of the work or other terms of this AGREEMENT, which cannot be resolved by negotiation and mutual concurrence between the parties, or through the administrative process provided in the contract, shall be resolved by arbitration as provided in Section 9-1.10, "Arbitration," of the Standard Specifications. Disputes between the DRB and either party, which cannot be resolved by negotiation and mutual concurrence, shall be resolved in the appropriate forum.

## **SECTION XI VENUE, APPLICABLE LAW, AND PERSONAL JURISDICTION**

In the event that any party deems it necessary to institute arbitration proceedings to enforce any right or obligation under this AGREEMENT, the parties hereto agree that such action shall be initiated in the Office of Administrative Hearings of the State of California. The parties hereto agree that all questions shall be resolved by arbitration by application of California law and that the parties to such arbitration shall have the right of appeal from such decisions to the Superior Court in conformance with the laws of the State of California. Venue for the arbitration shall be Sacramento or any other location as agreed to by the parties.

## **SECTION XII FEDERAL REVIEW AND REQUIREMENTS**

On Federal-Aid contracts, the Federal Highway Administration shall have the right to review the work of the DRB in progress, except for private meetings or deliberations of the DRB that do not become part of the project records.

Other Federal requirements in this agreement shall only apply to Federal-Aid contracts.

## **SECTION XIII CERTIFICATION OF CONTRACTOR, DRB, AND STATE**

IN WITNESS WHEREOF, the parties hereto have executed this AGREEMENT as of the day and year first above written.

DRB MEMBER

DRB MEMBER

By: \_\_\_\_\_

By: \_\_\_\_\_

Title: \_\_\_\_\_

Title : \_\_\_\_\_

DRB CHAIRPERSON

By : \_\_\_\_\_

Title : \_\_\_\_\_

CONTRACTOR

CALIFORNIA DEPARTMENT  
OF TRANSPORTATION

By: \_\_\_\_\_

By: \_\_\_\_\_

Title: \_\_\_\_\_

Title: \_\_\_\_\_

**Add:**

**5-1.16–5-17 (BLANK)**

**Add:**

**5-1.18 PROPERTY AND FACILITY PRESERVATION**

**5-1.18A General**

Preserve property and facilities, including:

1. Adjacent property
2. Department's instrumentation
3. ESAs
4. Lands administered by other agencies
5. Railroads and railroad equipment
6. Roadside vegetation not to be removed
7. Utilities
8. Waterways

Immediately report damage to the Engineer.

If you cause damage, you are responsible.

Install sheet piling, cribbing, bulkheads, shores, or other supports necessary to support existing facilities or support material carrying the facilities.

Dispose of temporary facilities when they are no longer needed.

If you damage plants not to be removed:

1. Dispose of them outside the right of way unless the Engineer allows you to reduce them to chips and spread the chips within the highway at locations designated by the Engineer
2. Replace them

Replace plants with plants of the same species.

Replace trees with 24-inch-box trees.

Replace shrubs with No. 15 container shrubs.

Replace ground cover plants with plants from flats. Replace *Carpobrotus* ground cover plants with plants from cuttings. Plant ground cover plants 1 foot on center.

If a plant establishment period is specified, replace plants before the start of the plant establishment period; otherwise, replace plants at least 30 days before Contract acceptance.

Water each plant immediately after planting and saturate the backfill soil around and below the roots or ball of earth around the roots of each plant. Water as necessary to maintain plants in a healthy condition until Contract acceptance.

The Department may make a temporary repair to restore service to a damaged facility.

If working on or adjacent to railroad property, do not interfere with railroad operations.

For an excavation on or affecting railroad property, submit work plans showing the system to be used to protect railroad facilities. Allow 65 days for the Engineer's review of the plans. Do not perform work based on the plans until the Engineer notifies you they are accepted.

**5-1.18B Nonhighway Facilities (Including Utilities)**

The Department may rearrange a nonhighway facility during the Contract. Rearrangement of a nonhighway facility includes installation, relocation, alteration, or removal of the facility. The Department may authorize facility owners and their agents to enter the highway to perform rearrangement work for their facilities or to make connections or repairs to their property. Coordinate activities to avoid delays.

Notify the Engineer at least 3 business days before you contact the regional notification center under Govt Code § 4216 et seq. Failure to contact the notification center prohibits excavation.

Before starting work that could damage or interfere with underground infrastructure, locate the infrastructure described in the Contract, including laterals and other appurtenances, and determine the presence of other underground infrastructure inferred from visible facilities such as buildings, meters, or junction boxes.





2. Improper operation
3. Insufficient maintenance
4. Abuse
5. Unauthorized change
6. Act of God

During the guarantee period, repair or replace each work portion having a substantial defect.

The Department does not pay for corrective work.

During corrective work activities, provide insurance coverage specified for coverage before contract acceptance.

The contract bonds must be in full force and effect until the later of:

1. Expiration of guarantee period
2. Completion of corrective work

If a warranty specification conflicts with Section 6-1.075, "Guarantee," comply with the warranty specification.

During the guarantee period, the Engineer monitors the completed work. If the Engineer finds work having a substantial defect, the Engineer lists work parts and furnishes you the list.

Within 10 days of receipt of the list, submit for authorization a detailed plan for correcting the work. Include a schedule that includes:

1. Start and completion dates
2. List of labor, equipment, materials, and any special services you plan to use
3. Work related to the corrective work, including traffic control and temporary and permanent pavement markings

The Engineer notifies you when the plan is authorized. Start corrective work and related work within 15 days of notice.

If the Engineer determines corrective work is urgently required to prevent injury or property damage:

1. The Engineer furnishes you a request to start emergency repair work and a list of parts requiring corrective work
2. Mobilize within 24 hours and start work
3. Submit a corrective work plan within 5 days of starting emergency repair work

If you fail to perform work as specified, the Department may perform the work and bill you.

**In Section 6-1.08 delete the 2nd paragraph.**

**Add:**

**6-1.085 BUY AMERICA (23 CFR 635.410)**

For a Federal-aid contract, furnish steel and iron materials to be incorporated into the work that are produced in the United States except:

1. Foreign pig iron and processed, pelletized, and reduced iron ore may be used in the domestic production of the steel and iron materials [60 Fed Reg 15478 (03/24/1995)]
2. If the total combined cost of the materials does not exceed the greater of 0.1 percent of the total bid or \$2,500, material produced outside the United States may be used

Production includes:

1. Processing steel and iron materials, including smelting or other processes that alter the physical form or shape (such as rolling, extruding, machining, bending, grinding, and drilling) or chemical composition
2. Coating application, including epoxy coating, galvanizing, and painting, that protects or enhances the value of steel and iron materials

For steel and iron materials to be incorporated into the work, submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications that certifies all production processes occurred in the United States except for the above exceptions.

**Add:**

**6-1.087 BUY AMERICA (PUB RES CODE § 42703(d))**

Furnish crumb rubber to be incorporated into the work that is produced in the United States and is derived from waste tires taken from vehicles owned and operated in the United States.

For crumb rubber to be incorporated into the work, submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications that certifies only crumb rubber manufactured in the United States and derived from waste tires taken from vehicles owned and operated in the United States is used.

**In Section 6-2.01 delete the 4th paragraph.**

**In Section 6-2.01 replace the 7th paragraph with:**

Upon the Contractor's written request, the Department tests materials from an untested local source. If satisfactory material from that source is used in the work, the Department does not charge the Contractor for the tests; otherwise, the Department deducts the test cost.

**In Section 6-2.01 delete the 8th paragraph.**

**In Section 6-2.02 delete the 3rd paragraph.**

**In Section 6-2.02 in the 7th paragraph, replace the 2nd sentence with:**

The Department deducts the charges for the removed material.

**In Section 6-2.03 in the 3rd paragraph, replace the 5th sentence with:**

No allowance or additional compensation will be made for lost time or for delay in completing the work due to moving the Contractor's plant from the designated mandatory source to the alternative mandatory source, other than a time adjustment as specified in Section 8-1.09, "Delays."

**In Section 6-3.01 delete the 4th paragraph.**

**In Section 6-3.01 in the 6th paragraph, delete the 1st sentence.**

**In Section 6-3.01 add:**

As used in Section 6-3.01, "Testing," tests are tests to assure the quality and to determine the acceptability of the work.

The Department deducts costs of testing work found to be noncompliant.

[illegible]

## SECTION 7 LEGAL RELATIONS AND RESPONSIBILITY

**(Issued 07-27-12)**

**Replace Section 7-1.01 with:**

**7-1.01 LAWS TO BE OBSERVED**

Comply with laws, regulations, orders, decrees, and PLACs applicable to the project. Indemnify and defend the State against any claim or liability arising from the violation of a law, regulation, order, decree, or PLAC by you or your employees. Immediately report to the Engineer in writing a discrepancy or inconsistency between the contract and a law, regulation, order, decree, or PLAC.

**In Section 7-1.01A replace the 1st clause with:**

Work on the job site must comply with Labor Code §§ 1727 and 1770-1815 and 8 CA Code of Regs § 16000 et seq. Work includes roadside production and processing of materials.

**In Section 7-1.01A(2) in the 1st paragraph, replace item 3 with:**

3. Upon becoming aware of the subcontractor's failure to pay the specified prevailing rate of wages to the subcontractor's workers, the Contractor must diligently take corrective action to stop or rectify the failure, including withholding sufficient funds due the subcontractor for work performed on the public works project.

**In Section 7-1.01A(2), replace the 2nd paragraph with:**

Pursuant to Section 1775 of the Labor Code, the Division of Labor Standards Enforcement must notify the Contractor on a public works project within 15 days of the receipt by the Division of Labor Standards Enforcement of a complaint of the failure of a subcontractor on that public works project to pay workers the general prevailing rate of per diem wages. If the Division of Labor Standards Enforcement determines that employees of a subcontractor were not paid the general prevailing rate of per diem wages and if the Department did not withhold sufficient money under the contract to pay those employees the balance of wages owed under the general prevailing rate of per diem wages, the Contractor must withhold an amount of moneys due the subcontractor sufficient to pay those employees the general prevailing rate of per diem wages if requested by the Division of Labor Standards Enforcement. The Contractor must pay any money withheld from and owed to a subcontractor upon receipt of notification by the Division of Labor Standards Enforcement that the wage complaint has been resolved. If notice of the resolution of the wage complaint has not been received by the Contractor within 180 days of the filing of a valid notice of completion or acceptance of the public works project, whichever occurs later, the Contractor must pay all moneys withheld from the subcontractor to the Department. The Department withholds these moneys pending the final decision of an enforcement action.

**In Section 7-1.01A(2) replace 7th paragraph with:**

Changes in general prevailing wage determinations apply to the contract when the Director of Industrial Relations has issued them at least 10 days before advertisement (Labor Code § 1773.6 and 8 CA Code of Regs 16204).

**In Section 7-1.01A(3) replace the 2nd paragraph with:**

The Department withholds the penalties specified in subdivision (g) of Labor Code § 1776 for noncompliance with the requirements in Section 1776.

**In Section 7-1.01A(3) replace the 4th paragraph with:**

The Department withholds for delinquent or inadequate payroll records (Labor Code § 1771.5). If the Contractor has not submitted an adequate payroll record by the month's 15th day for the period ending on or before the 1st of that month, the Department withholds 10 percent of the monthly progress estimate, exclusive of mobilization. The Department does not withhold more than \$10,000 or less than \$1,000.

**In Section 7-1.01A(3) delete the 5th paragraph.**

**Replace Section 7-1.01A(6) with:**

**7-1.01A(6) (Blank)**

**Replace Section 7-1.01A(7) with:**

**7-1.01A(7) (Blank)**

**Replace Section 7-1.01F with:**

**7-1.01F Environmental Stewardship**

Comply with Section 14.

**Replace Section 7-1.01I with:**

**7-1.01I (Blank)**

**In Section 7-1.02 in the 2nd paragraph, replace the 4th sentence with:**

Trucks used to haul treated base, portland cement concrete, or hot mix asphalt shall enter onto the base to dump at the nearest practical entry point ahead of spreading equipment.

**In Section 7-1.02 between the 4th and 5th paragraphs, add:**

Loads imposed on existing, new, or partially completed structures shall not exceed the load carrying capacity of the structure or any portion of the structure as determined by AASHTO LRFD with interims and California Amendments, Design Strength Limit State II. The compressive strength of concrete ( $f'_c$ ) to be used in computing the load carrying capacity shall be the smaller of the following:

1. Actual compressive strength at the time of loading
2. Value of  $f'_c$  shown on the plans for that portion of the structure or 2.5 times the value of  $f'_c$  (extreme fiber compressive stress in concrete at service loads) shown on the plans for portions of the structure where no  $f'_c$  is shown

**Replace Section 7-1.04 with:**

**7-1.04 PERMITS, LICENSES, AGREEMENTS, AND CERTIFICATIONS**

**7-1.04A General**

Comply with PLACs. The Department makes PLAC changes under Section 4-1.03, "Changes."

**7-1.04B Before Award**

To make a change to a PLAC made available to you before award, submit the proposed change. The Department sends the proposed change to the appropriate authority for consideration.

**7-1.04C After Award**

Confirm with the Engineer which after-award PLACs are obtained by the Department and which are obtained by the Contractor.

To make a change to an after-award PLAC obtained by the Department, submit the proposed change. The Department sends the proposed change to the appropriate authority for consideration.

Obtain those PLACs to be issued to you and pay fees and costs associated with obtaining them. Submit copies of Contractor-obtained after-award PLACs for review.

**In Section 7-1.06 in the 1st paragraph, add:**

The Contractor's Injury and Illness Prevention Program shall be submitted to the Engineer. The program shall address the use of personal and company issued electronic devices during work. The use of entertainment and personal communication devices in the work zone shall not be allowed. Workers may use a communication device for business purposes in the work area, at a location where their safety and the safety of other workers and the traveling public is not compromised.

**Replace Section 7-1.07 with:**

**7-1.07 Lead Compliance Plan**

Section 7-1.07 applies if a bid item for a lead compliance plan is included in the Contract.

Prepare a work plan to prevent or minimize worker exposure to lead while managing and handling earth materials, paint system debris, traffic stripe residue, and pavement marking residue containing lead. Regulations containing specific Cal/OSHA requirements when working with lead include 8 CA Code of Regs § 1532.1.

The plan must contain the items listed in 8 CA Code of Regs § 1532.1(e)(2)(B). Before submittal, a CIH must sign and seal the plan. Submit the plan at least 7 days before starting any activity that presents the potential for lead exposure. The Engineer notifies you of the acceptability of the plan within 4 business days of receipt.

Before starting any activity that presents the potential for lead exposure to employees who have no prior training, including State employees, provide a safety training program to these employees that complies with 8 CA Code of Regs § 1532.1 and your lead compliance program.

Submit copies of air monitoring or job site inspection reports made by or under the direction of the CIH under 8 CA Code of Regs § 1532.1 within 10 days after the date of monitoring or inspection.

Supply personal protective equipment, training, and washing facilities required by your lead compliance plan for 5 State employees.

The contract lump sum price paid for lead compliance plan includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in preparing and implementing the plan as specified in this section.

**Replace Section 7-1.08 with:**

**7-1.08 PUBLIC CONVENIENCE**

Compliance with the provisions of this section does not relieve you of your responsibility for public safety.

Construction activities must not inconvenience the public or abutting property owners. Schedule and conduct work to avoid unnecessary inconvenience to the public and abutting property owners. Avoid undue delay in construction activities to reduce the public's exposure to construction.

Where possible, route traffic on new or existing paved surfaces.

Maintain convenient access to driveways, houses, and buildings. When the abutting property owner's access across the right of way line is to be eliminated or replaced under the contract, the existing access must not be closed until the replacement access facilities are usable. Construct temporary approaches to crossings and intersecting highways.

Provide a reasonably smooth and even surface for use by traffic at all time during excavation of roadways and construction of embankments. Before other grading activities, place fill at culverts and bridges to allow traffic to cross. If ordered, excavate roadway cuts in layers and construct embankments in partial widths at a time alternating construction from one side to the other and routing traffic over the side opposite the one under construction. Install or construct culverts on only 1/2 the width of the traveled way at a time; keep the traveled way portion being used by traffic open and unobstructed until the opposite side of the traveled way is ready for use by traffic.

Upon completion of rough grading or placing any subsequent layer, bring the surface of the roadbed to a smooth and even condition, free of humps and depressions and satisfactory for the use of the public.

After subgrade preparation for a specified layer of material has been completed, repair any damage to the roadbed or completed subgrade, including damage due to use by the public.

While subgrade and paving activities are underway, allow the public to use the shoulders. If half-width paving methods are used, allow the public to use the side of the roadbed opposite the one under construction. If enough width is available, keep open a passageway wide enough to accommodate at least 2 lanes of traffic at locations where subgrade and paving activities are underway. Shape shoulders or reshape subgrade as necessary to accommodate traffic during subgrade preparation and paving activities.

Apply water or dust palliative for the prevention or alleviation of dust nuisance.

Install signs, lights, flares, temporary railing (Type K), barricades and other facilities to direct traffic. Furnish flaggers whenever necessary to direct the movement of the public through or around the work.

You will be required to pay the cost of replacing or repairing all facilities installed under extra work for the convenience or direction or warning of the public which are lost while in your custody, or are damaged by your operations to such an extent as to require replacement or repair.

The Engineer may order or consent to your request to open a completed section of surfacing, pavement, or structure roadway surface for public use. You will not be compensated for any delay to your construction activities caused by the public. This does not relieve you from any other contractual responsibility.

**Replace Section 7-1.09 with:**

**7-1.09 PUBLIC SAFETY**

You are responsible to provide for public safety.

Do not construct a temporary facility that interferes with the safe passage of traffic.

Control dust resulting from the work, inside and outside the right-of-way.

Move workers, equipment, and materials without endangering traffic.

Whenever your operations create a condition hazardous to the public, furnish, erect and maintain those fences, temporary railing, barricades, lights, signs, and other devices and take any other necessary protective measures to prevent damage or injury to the public.

Any fences, temporary railing, barricades, lights, signs, or other devices furnished, erected and maintained by you are in addition to those for which payment is provided elsewhere in the specifications.

Provide flaggers whenever necessary to ensure that the public is given safe guidance through the work zone. Except as ordered, at locations where traffic is being routed through construction under one-way controls, move your equipment in compliance with the one-way controls.

Use of signs, lights, flags, or other protective devices must conform with the California MUTCD and as ordered. Signs, lights, flags or other protective devices must not obscure the visibility of, nor conflict in intent, meaning and function of either existing signs, lights and traffic control devices or any construction area signs or traffic control devices.

Keep existing traffic signals and highway lighting in operation. Other entities perform routine maintenance of these facilities during the work.

Cover signs that direct traffic to a closed area. Providing, maintaining, and removing the covers on construction area signs is paid as extra work under Section 4-1.03D, "Extra Work."

Install temporary illumination in a manner which the illumination and the illumination equipment does not interfere with public safety. The installation of general roadway illumination does not relieve you from furnishing and maintaining any protective devices.

Equipment must enter and leave the highway via existing ramps and crossovers and must move in the direction of public traffic. All movements of workmen and construction equipment on or across lanes open to public traffic must be performed in a manner that will not endanger the public. Your vehicles or other mobile equipment leaving an open traffic lane to enter the construction area, must slow down gradually in advance of the location of the turnoff to give traffic following an opportunity to slow down. When leaving a work area and entering a roadway carrying public traffic, your vehicles and equipment must yield to public traffic.

Immediately remove hauling spillage from roadway lanes or shoulders open to traffic. When hauling on roadways, trim loads and remove material from shelf areas to minimize spillage.

Notify the Engineer not less than 25 days and not more than 125 days before the anticipated start of an activity that will change the vertical or horizontal clearance available to public traffic, including shoulders.

If vertical clearance is temporarily reduced to 15.5 feet or less, place low clearance warning signs in accordance with the California MUTCD and as ordered. Signs must comply with the dimensions, color, and legend requirements of the California MUTCD and these specifications except that the signs must have black letters and numbers on an orange retroreflective background. W12-2P signs must be illuminated so that the signs are clearly visible.

Pave or provide full width continuous and cleared wood walks for pedestrian openings through falsework. Protect pedestrians from falling objects and curing water for concrete. Extend overhead protection for pedestrians not less than 4 feet beyond the edge of the bridge deck. Illuminate all pedestrian openings through falsework. Temporary pedestrian facilities must comply with the American with Disabilities Act of 1990 (ADA).

Do not store vehicles, material, or equipment in a way that:

1. Creates a hazard to the public
2. Obstructs traffic control devices

Do not install or place temporary facilities used to perform the work which interfere with the free and safe passage of public traffic.

Temporary facilities which could be a hazard to public safety if improperly designed shall comply with design requirements specified in the contract for those facilities or, if none are specified, with standard design criteria or codes appropriate for the facility involved. Working drawings and design calculations for the temporary facilities shall be prepared and signed by an engineer who is registered as a Civil Engineer in the State of California and shall be submitted to the Engineer for approval pursuant to Section 5-1.02, "Plans and Working Drawings." The

submittals shall designate thereon the standard design criteria or codes used. Installation of the temporary facilities shall not start until the Engineer has reviewed and approved the drawings.

If you appear to be neglectful or negligent in furnishing warning devices and taking protective measures, the Engineer may direct your attention to the existence of a hazard and the necessary warning devices must be furnished and installed and protective measures taken by you. If the Engineer points out the inadequacy of warning devices and protective measures, that action on the part of the Engineer does not relieve you from your responsibility for public safety or abrogate the obligation to furnish and pay for these devices and measures.

Install temporary railing (Type K) or other approved protection system under the following conditions:

1. Excavations: Where the near edge of the excavation is within 15 feet from the edge of an open traffic lane
2. Temporarily Unprotected Permanent Obstacles: When the work includes the installation of a fixed obstacle together with a protective system, such as a sign structure together with protective railing, and you elect to install the obstacle before installing the protective system; or you, for your convenience and as authorized, remove a portion of an existing protective railing at an obstacle and do not replace such railing completely the same day
3. Storage Areas: When material or equipment is stored within 15 feet of the edge of an open traffic lane and the storage is not otherwise prohibited by the provisions of these Standard Specifications and the special provisions
4. Height Differentials: When construction operations create a height differential greater than 0.15 feet within 15 feet of the edge of traffic lane

Temporary railing (Type K) does not need to be installed where excavations within 15 feet from edge of an open traffic lane are:

1. Covered with steel plates or concrete covers of adequate thickness to prevent accidental entry by traffic or the public
2. In side slopes, where the downhill slope is 4:1 (horizontal:vertical) or less unless a naturally occurring condition
3. Protected by existing barrier or railing

Offset the approach end of temporary railing (Type K) a minimum of 15 feet from the edge of an open traffic lane. Install the temporary railing on a skew toward the edge of the traffic lane of not more than one foot transversely to 10 feet longitudinally with respect to the edge of the traffic lane. If the 15-foot minimum offset cannot be achieved, the temporary railing must be installed on the 10 to 1 skew to obtain the maximum available offset between the approach end of the railing and the edge of the traffic lane, and an array of temporary crash cushion modules must be installed at the approach end of the temporary railing.

Secure in place temporary railing (Type K) before starting work for which the temporary railing is required.

Where 2 or more lanes in the same direction are adjacent to the area where the work is being performed, including shoulders, the adjacent lane must be closed under any of the following conditions:

1. Work is off the traveled way but within 6 feet of the edge of traveled way, and approach speed is greater than 45 miles per hour
2. Work is off the traveled way but within 3 feet of the edge of traveled way, and approach speed is less than 45 miles per hour

Closure of the adjacent traffic lane is not required when:

1. Performing work behind a barrier
2. Paving, grinding, or grooving
3. Installing, maintaining, or removing traffic control devices except temporary railing (Type K)

Do not reduce an open traffic lane width to less than 10 feet. When traffic cones or delineators are used for temporary edge delineation, the line of cones or delineators is considered the edge of the traveled way.

If a traffic lane is closed with channelizers for excavation work, move the devices to the adjacent edge of the traveled way when not excavating. Space the devices the same as specified for the lane closure.

Do not move or temporarily suspend anything over a traffic lane open to the public unless the public is protected.

**Replace Section 7-1.11 with:**

**7-1.11 PRESERVATION OF PROPERTY**

Comply with Section 5-1.18, "Property and Facility Preservation."

**Replace Section 7-1.12 with:**

**7-1.12 INDEMNIFICATION AND INSURANCE**

The Contractor's obligations regarding indemnification of the State of California and the requirements for insurance shall conform to the provisions in Section 3-1.05, "Insurance Policies," and Sections 7-1.12A, "Indemnification," and 7-1.12B, "Insurance," of this Section 7-1.12.

**7-1.12A Indemnification**

The Contractor shall defend, indemnify, and save harmless the State, including its officers, employees, and agents (excluding agents who are design professionals) from any and all claims, demands, causes of action, damages, costs, expenses, actual attorneys' fees, losses or liabilities, in law or in equity (Section 7-1.12A Claims) arising out of or in connection with the Contractor's performance of this contract for:

1. Bodily injury including, but not limited to, bodily injury, sickness or disease, emotional injury or death to persons, including, but not limited to, the public, any employees or agents of the Contractor, the State, or any other contractor; and
2. Damage to property of anyone including loss of use thereof; caused or alleged to be caused in whole or in part by any negligent or otherwise legally actionable act or omission of the Contractor or anyone directly or indirectly employed by the Contractor or anyone for whose acts the Contractor may be liable.

Except as otherwise provided by law, these requirements apply regardless of the existence or degree of fault of the State. The Contractor is not obligated to indemnify the State for Claims arising from conduct delineated in Civil Code Section 2782 and to Claims arising from any defective or substandard condition of the highway that existed at or before the start of work, unless this condition has been changed by the work or the scope of the work requires the Contractor to maintain existing highway facilities and the Claim arises from the Contractor's failure to maintain. The Contractor's defense and indemnity obligation shall extend to Claims arising after the work is completed and accepted if the Claims are directly related to alleged acts or omissions by the Contractor that occurred during the course of the work. State inspection is not a waiver of full compliance with these requirements.

The Contractor's obligation to defend and indemnify shall not be excused because of the Contractor's inability to evaluate liability or because the Contractor evaluates liability and determine that the Contractor is not liable. The Contractor shall respond within 30 days to the tender of any Claim for defense and indemnity by the State, unless this time has been extended by the State. If the Contractor fails to accept or reject a tender of defense and indemnity within 30 days, in addition to any other remedy authorized by law, the Department may withhold such funds the State reasonably considers necessary for its defense and indemnity until disposition has been made of the Claim or until the Contractor accepts or rejects the tender of defense, whichever occurs first.

With respect to third-party claims against the Contractor, the Contractor waives all rights of any type to express or implied indemnity against the State, its officers, employees, or agents (excluding agents who are design professionals).

Nothing in the Contract is intended to establish a standard of care owed to any member of the public or to extend to the public the status of a third-party beneficiary for any of these indemnification specifications.

**7-1.12B Insurance**

**7-1.12B(1) General**

Nothing in the contract is intended to establish a standard of care owed to any member of the public or to extend to the public the status of a third-party beneficiary for any of these insurance specifications.

**7-1.12B(2) Casualty Insurance**

The Contractor shall procure and maintain insurance on all of its operations with companies acceptable to the State as follows:

1. The Contractor shall keep all insurance in full force and effect from the beginning of the work through contract acceptance.



2. All insurance shall be with an insurance company with a rating from A.M. Best Financial Strength Rating of A- or better and a Financial Size Category of VII or better.
3. The Contractor shall maintain completed operations coverage with a carrier acceptable to the State through the expiration of the patent deficiency in construction statute of repose set forth in Code of Civil Procedure Section 337.15.

#### **7-1.12B(3) Workers' Compensation and Employer's Liability Insurance**

In accordance with Labor Code Section 1860, the Contractor shall secure the payment of worker's compensation in accordance with Labor Code Section 3700.

In accordance with Labor Code Section 1861, the Contractor shall submit to the Department the following certification before performing the work:

I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this contract.

Contract execution constitutes certification submittal.

The Contractor shall provide Employer's Liability Insurance in amounts not less than:

1. \$1,000,000 for each accident for bodily injury by accident
2. \$1,000,000 policy limit for bodily injury by disease
3. \$1,000,000 for each employee for bodily injury by disease

If there is an exposure of injury to the Contractor's employees under the U.S. Longshoremen's and Harbor Workers' Compensation Act, the Jones Act, or under laws, regulations, or statutes applicable to maritime employees, coverage shall be included for such injuries or claims.

#### **7-1.12B(4) Liability Insurance**

##### **7-1.12B(4)(a) General**

The Contractor shall carry General Liability and Umbrella or Excess Liability Insurance covering all operations by or on behalf of the Contractor providing insurance for bodily injury liability and property damage liability for the following limits and including coverage for:

1. Premises, operations, and mobile equipment
2. Products and completed operations
3. Broad form property damage (including completed operations)
4. Explosion, collapse, and underground hazards
5. Personal injury
6. Contractual liability

##### **7-1.12B(4)(b) Liability Limits/Additional Insureds**

The limits of liability shall be at least the amounts shown in the following table:

| Total Bid   | For Each Occurrence <sup>1</sup> | Aggregate for Products/Completed Operation | General Aggregate <sup>2</sup> | Umbrella or Excess Liability <sup>3</sup> |
|---|----------------------------------|--|--------------------------------|---|
| ≤\$1,000,000  | \$1,000,000                      | \$2,000,000                                | \$2,000,000                    | \$5,000,000                               |
| >\$1,000,000<br>≤\$10,000,000   | \$1,000,000                      | \$2,000,000                                | \$2,000,000                    | \$10,000,000                              |
| >\$10,000,000<br>≤\$25,000,000  | \$2,000,000                      | \$2,000,000                                | \$4,000,000                    | \$15,000,000                              |
| >\$25,000,000   | \$2,000,000                      | \$2,000,000                                | \$4,000,000                    | \$25,000,000                              |
| <ol style="list-style-type: none"> <li>1. Combined single limit for bodily injury and property damage.</li> <li>2. This limit shall apply separately to the Contractor's work under this contract.</li> <li>3. The umbrella or excess policy shall contain a clause stating that it takes effect (drops down) in the event the primary limits are impaired or exhausted.</li> </ol> |                                  |  |                                |   |

The Contractor shall not require certified Small Business subcontractors to carry Liability Insurance that exceeds the limits in the table above. Notwithstanding the limits specified herein, at the option of the Contractor, the liability insurance limits for certified Small Business subcontractors of any tier may be less than those limits specified in the table. For Small Business subcontracts, "Total Bid" shall be interpreted as the amount of subcontracted work to a certified Small Business.

The State, including its officers, directors, agents (excluding agents who are design professionals), and employees, shall be named as additional insureds under the General Liability and Umbrella Liability Policies with respect to liability arising out of or connected with work or operations performed by or on behalf of the Contractor under this contract. Coverage for such additional insureds does not extend to liability:

1. Arising from any defective or substandard condition of the roadway which existed at or before the time the Contractor started work, unless such condition has been changed by the work or the scope of the work requires the Contractor to maintain existing roadway facilities and the claim arises from the Contractor's failure to maintain;
2. For claims occurring after the work is completed and accepted unless these claims are directly related to alleged acts or omissions of the Contractor that occurred during the course of the work; or
3. To the extent prohibited by Insurance Code Section 11580.04

Additional insured coverage shall be provided by a policy provision or by an endorsement providing coverage at least as broad as Additional Insured (Form B) endorsement form CG 2010, as published by the Insurance Services Office (ISO), or other form designated by the Department.

#### **7-1.12B(4)(c) Contractor's Insurance Policy is Primary**

The policy shall stipulate that the insurance afforded the additional insureds applies as primary insurance. Any other insurance or self-insurance maintained by the State is excess only and shall not be called upon to contribute with this insurance.

#### **7-1.12B(5) Automobile Liability Insurance**

The Contractor shall carry automobile liability insurance, including coverage for all owned, hired, and nonowned automobiles. The primary limits of liability shall be not less than \$1,000,000 combined single limit each accident for bodily injury and property damage. The umbrella or excess liability coverage required under Section 7-1.12B(4)(b) also applies to automobile liability.

#### **7-1.12B(6) Policy Forms, Endorsements, and Certificates**

The Contractor shall provide its General Liability Insurance under Commercial General Liability policy form No. CG0001 as published by the Insurance Services Office (ISO) or under a policy form at least as broad as policy form No. CG0001.

#### **7-1.12B(7) Deductibles**

The State may expressly allow deductible clauses, which it does not consider excessive, overly broad, or harmful to the interests of the State. Regardless of the allowance of exclusions or deductions by the State, the Contractor is responsible for any deductible amount and shall warrant that the coverage provided to the State is in accordance with Section 7-1.12B, "Insurance."

#### **7-1.12B(8) Enforcement**

The Department may assure the Contractor's compliance with its insurance obligations. Ten days before an insurance policy lapses or is canceled during the contract period, the Contractor shall submit to the Department evidence of renewal or replacement of the policy.

If the Contractor fails to maintain any required insurance coverage, the Department may maintain this coverage and withhold or charge the expense to the Contractor or terminate the Contractor's control of the work in accordance with Section 8-1.08, "Termination of Control."

The Contractor is not relieved of its duties and responsibilities to indemnify, defend, and hold harmless the State, its officers, agents, and employees by the Department's acceptance of insurance policies and certificates.

Minimum insurance coverage amounts do not relieve the Contractor for liability in excess of such coverage, nor do they preclude the State from taking other actions available to it, including the withholding of funds under this contract.

#### **7-1.12B(9) Self-Insurance**

Self-insurance programs and self-insured retentions in insurance policies are subject to separate annual review and approval by the State.

If the Contractor uses a self-insurance program or self-insured retention, the Contractor shall provide the State with the same protection from liability and defense of suits as would be afforded by first-dollar insurance. Execution of the contract is the Contractor's acknowledgement that the Contractor will be bound by all laws as if the Contractor were an insurer as defined under Insurance Code Section 23 and that the self-insurance program or self-insured retention shall operate as insurance as defined under Insurance Code Section 22.

#### **Replace Section 7-1.125 with:**

##### **7-1.125 Legal Actions Against the Department**

If legal action is brought against the Department over compliance with a State or Federal law, rule, or regulation applicable to highway work, then:

1. If the Department, in complying with a court order, prohibits you from performing work, the resulting delay is a suspension related to your performance, unless the Department terminates the contract.
2. If a court order other than an order to show cause or the final judgment in the action prohibits the Department from requiring you to perform work, the Department may delete the prohibited work or terminate the contract.

#### **In Section 7-1.13 delete the 5th and 6th paragraphs.**

#### **Add:**

##### **7-1.50 FEDERAL LAWS FOR FEDERAL-AID CONTRACTS**

###### **7-1.50A General**

Section 7-1.50, "Federal Laws for Federal-Aid Contracts," includes specifications required in a Federal-aid construction contract and applies to a Federal-aid contract.

A copy of form FHWA-1273 is included in Section 7-1.50B, "FHWA-1273." The training and promotion section of section II refers to training provisions as if they were included in the special provisions. The Department specifies the provisions in section 7-1.11D of the Standard Specifications. If a number of trainees or apprentices is required, the Department specifies the number in the special provisions. Interpret each FHWA-1273 clause shown in the following table as having the same meaning as the corresponding Department clause:

**FHWA-1273 Nondiscrimination Clauses**

| FHWA-1273 section      | FHWA-1273 clause   | Department clause   |
|------------------------|--|---|
| Training and Promotion | In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. | If section 7-1.11D applies, section 7-1.11D supersedes this subparagraph.       |
| Records and Reports    | If on-the-job training is being required by special provision, the contractor will be required to collect and report training data.                        | If the Contract requires on-the-job training, collect and report training data. |

###### **7-1.50B FHWA-1273**

## REQUIRED CONTRACT PROVISIONS FEDERAL-AID CONSTRUCTION CONTRACTS

- I. General
- II. Nondiscrimination
- III. Nonsegregated Facilities
- IV. Davis-Bacon and Related Act Provisions
- V. Contract Work Hours and Safety Standards Act Provisions
- VI. Subletting or Assigning the Contract
- VII. Safety: Accident Prevention
- VIII. False Statements Concerning Highway Projects
- IX. Implementation of Clean Air Act and Federal Water Pollution Control Act
- X. Compliance with Governmentwide Suspension and Debarment Requirements
- XI. Certification Regarding Use of Contract Funds for Lobbying

### ATTACHMENTS

A. Employment and Materials Preference for Appalachian Development Highway System or Appalachian Local Access Road Contracts (included in Appalachian contracts only)

### I. GENERAL

1. Form FHWA-1273 must be physically incorporated in each construction contract funded under Title 23 (excluding emergency contracts solely intended for debris removal). The contractor (or subcontractor) must insert this form in each subcontract and further require its inclusion in all lower tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services).

The applicable requirements of Form FHWA-1273 are incorporated by reference for work done under any purchase order, rental agreement or agreement for other services. The prime contractor shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Form FHWA-1273 must be included in all Federal-aid design-build contracts, in all subcontracts and in lower tier subcontracts (excluding subcontracts for design services, purchase orders, rental agreements and other agreements for supplies or services). The design-builder shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Contracting agencies may reference Form FHWA-1273 in bid proposal or request for proposal documents, however, the Form FHWA-1273 must be physically incorporated (not referenced) in all contracts, subcontracts and lower-tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services related to a construction contract).

2. Subject to the applicability criteria noted in the following sections, these contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.

3. A breach of any of the stipulations contained in these Required Contract Provisions may be sufficient grounds for withholding of progress payments, withholding of final payment, termination of the contract, suspension / debarment or any other action determined to be appropriate by the contracting agency and FHWA.

4. Selection of Labor: During the performance of this contract, the contractor shall not use convict labor for any purpose within the limits of a construction project on a Federal-aid highway unless it is labor performed by convicts who are on parole, supervised release, or probation. The term Federal-aid highway does not include roadways functionally classified as local roads or rural minor collectors.

### II. NONDISCRIMINATION

The provisions of this section related to 23 CFR Part 230 are applicable to all Federal-aid construction contracts and to all related construction subcontracts of \$10,000 or more. The provisions of 23 CFR Part 230 are not applicable to material supply, engineering, or architectural service contracts.

In addition, the contractor and all subcontractors must comply with the following policies: Executive Order 11246, 41 CFR 60, 29 CFR 1625-1627, Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The contractor and all subcontractors must comply with: the requirements of the Equal Opportunity Clause in 41 CFR 60-1.4(b) and, for all construction contracts exceeding \$10,000, the Standard Federal Equal Employment Opportunity Construction Contract Specifications in 41 CFR 60-4.3.

Note: The U.S. Department of Labor has exclusive authority to determine compliance with Executive Order 11246 and the policies of the Secretary of Labor including 41 CFR 60, and 29 CFR 1625-1627. The contracting agency and the FHWA have the authority and the responsibility to ensure compliance with Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), and Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The following provision is adopted from 23 CFR 230, Appendix A, with appropriate revisions to conform to the U.S. Department of Labor (US DOL) and FHWA requirements.

**1. Equal Employment Opportunity:** Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630, 29 CFR 1625-1627, 41 CFR 60 and 49 CFR 27) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under

this contract. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR 35 and 29 CFR 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

a. The contractor will work with the contracting agency and the Federal Government to ensure that it has made every good faith effort to provide equal opportunity with respect to all of its terms and conditions of employment and in their review of activities under the contract.

b. The contractor will accept as its operating policy the following statement:

"It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training."

**2. EEO Officer:** The contractor will designate and make known to the contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active EEO program and who must be assigned adequate authority and responsibility to do so.

**3. Dissemination of Policy:** All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.

b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minorities and women.

d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

**4. Recruitment:** When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minorities and women in the area from which the project work force would normally be derived.

a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minorities and women. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority and women applicants may be referred to the contractor for employment consideration.

b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the contractor is expected to observe the provisions of that agreement to the extent that the system meets the contractor's compliance with EEO contract provisions. Where implementation of such an agreement has the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Federal nondiscrimination provisions.

c. The contractor will encourage its present employees to refer minorities and women as applicants for employment. Information and procedures with regard to referring such applicants will be discussed with employees.

**5. Personnel Actions:** Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:

a. The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.

b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with its obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of their avenues of appeal.

**6. Training and Promotion:**

a. The contractor will assist in locating, qualifying, and increasing the skills of minorities and women who are

applicants for employment or current employees. Such efforts should be aimed at developing full journey level status employees in the type of trade or job classification involved.

b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. The contracting agency may reserve training positions for persons who receive welfare assistance in accordance with 23 U.S.C. 140(a).

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of employees who are minorities and women and will encourage eligible employees to apply for such training and promotion.

**7. Unions:** If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use good faith efforts to obtain the cooperation of such unions to increase opportunities for minorities and women. Actions by the contractor, either directly or through a contractor's association acting as agent, will include the procedures set forth below:

a. The contractor will use good faith efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minorities and women for membership in the unions and increasing the skills of minorities and women so that they may qualify for higher paying employment.

b. The contractor will use good faith efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.

c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the contracting agency and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin, age or disability; making full efforts to obtain qualified and/or qualifiable minorities and women. The failure of a union to provide sufficient referrals (even though it is obligated to provide exclusive referrals under the terms of a collective bargaining agreement) does not relieve the contractor from the requirements of this paragraph. In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the contracting agency.

**8. Reasonable Accommodation for Applicants / Employees with Disabilities:** The contractor must be familiar

with the requirements for and comply with the Americans with Disabilities Act and all rules and regulations established there under. Employers must provide reasonable accommodation in all employment activities unless to do so would cause an undue hardship.

**9. Selection of Subcontractors, Procurement of Materials and Leasing of Equipment:** The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of this contract.

a. The contractor shall notify all potential subcontractors and suppliers and lessors of their EEO obligations under this contract.

b. The contractor will use good faith efforts to ensure subcontractor compliance with their EEO obligations.

#### **10. Assurance Required by 49 CFR 26.13(b):**

a. The requirements of 49 CFR Part 26 and the State DOT's U.S. DOT-approved DBE program are incorporated by reference.

b. The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the contracting agency deems appropriate.

**11. Records and Reports:** The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following the date of the final payment to the contractor for all contract work and shall be available at reasonable times and places for inspection by authorized representatives of the contracting agency and the FHWA.

a. The records kept by the contractor shall document the following:

(1) The number and work hours of minority and non-minority group members and women employed in each work classification on the project;

(2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women; and

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minorities and women;

b. The contractors and subcontractors will submit an annual report to the contracting agency each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on [Form FHWA-1391](#). The staffing data should represent the project work force on board in all or any part of the last payroll period preceding the end of July. If on-the-job training is being required by special provision, the contractor

will be required to collect and report training data. The employment data should reflect the work force on board during all or any part of the last payroll period preceding the end of July.

### III. NONSEGREGATED FACILITIES

This provision is applicable to all Federal-aid construction contracts and to all related construction subcontracts of \$10,000 or more.

The contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensure that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. The term "facilities" includes waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. The contractor shall provide separate or single-user restrooms and necessary dressing or sleeping areas to assure privacy between sexes.

### IV. DAVIS-BACON AND RELATED ACT PROVISIONS

This section is applicable to all Federal-aid construction projects exceeding \$2,000 and to all related subcontracts and lower-tier subcontracts (regardless of subcontract size). The requirements apply to all projects located within the right-of-way of a roadway that is functionally classified as Federal-aid highway. This excludes roadways functionally classified as local roads or rural minor collectors, which are exempt. Contracting agencies may elect to apply these requirements to other projects.

The following provisions are from the U.S. Department of Labor regulations in 29 CFR 5.5 "Contract provisions and related matters" with minor revisions to conform to the FHWA-1273 format and FHWA program requirements.

#### 1. Minimum wages

a. All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions

of paragraph 1.d. of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph 1.b. of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

b. (1) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(ii) The classification is utilized in the area by the construction industry; and

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(3) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. The Wage and Hour Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or

will notify the contracting officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs 1.b.(2) or 1.b.(3) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

c. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

d. If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program. Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

## 2. Withholding

The contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract, or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the contracting agency may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

## 3. Payrolls and basic records

a. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-

Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

b.(1) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the contracting agency. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/esa/whd/forms/wh347instr.htm> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the contracting agency for transmission to the State DOT, the FHWA or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the contracting agency..

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(i) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.



(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 3.b.(2) of this section.

(4) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

c. The contractor or subcontractor shall make the records required under paragraph 3.a. of this section available for inspection, copying, or transcription by authorized representatives of the contracting agency, the State DOT, the FHWA, or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the FHWA may, after written notice to the contractor, the contracting agency or the State DOT, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

#### 4. Apprentices and trainees

##### a. Apprentices (programs of the USDOL).

Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice.

The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly

rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

##### b. Trainees (programs of the USDOL).

Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration.

The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration.

Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

d. Apprentices and Trainees (programs of the U.S. DOT).

Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

**5. Compliance with Copeland Act requirements.** The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

**6. Subcontracts.** The contractor or subcontractor shall insert Form FHWA-1273 in any subcontracts and also require the subcontractors to include Form FHWA-1273 in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

**7. Contract termination: debarment.** A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

**8. Compliance with Davis-Bacon and Related Act requirements.** All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

**9. Disputes concerning labor standards.** Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

**10. Certification of eligibility.**

a. By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

c. The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

**V. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT**

The following clauses apply to any Federal-aid construction contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

**1. Overtime requirements.** No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

**2. Violation; liability for unpaid wages; liquidated damages.** In the event of any violation of the clause set forth in paragraph (1.) of this section, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1.) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1.) of this section.

**3. Withholding for unpaid wages and liquidated damages.** The FHWA or the contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2.) of this section.

**4. Subcontracts.** The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1.) through (4.) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1.) through (4.) of this section.

## **VI. SUBLETTING OR ASSIGNING THE CONTRACT**

This provision is applicable to all Federal-aid construction contracts on the National Highway System.

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the contracting agency. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635.116).

a. The term "perform work with its own organization" refers to workers employed or leased by the prime contractor, and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor or lower tier subcontractor, agents of the prime contractor, or any other assignees. The term may include payments for the costs of hiring leased employees from an employee leasing firm meeting all relevant Federal and State regulatory requirements. Leased employees may only be included in this term if the prime contractor meets all of the following conditions:

- (1) the prime contractor maintains control over the supervision of the day-to-day activities of the leased employees;
- (2) the prime contractor remains responsible for the quality of the work of the leased employees;
- (3) the prime contractor retains all power to accept or exclude individual employees from work on the project; and
- (4) the prime contractor remains ultimately responsible for the payment of predetermined minimum wages, the submission of payrolls, statements of compliance and all other Federal regulatory requirements.

b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid or propose on the contract as a whole and in general are to be limited to minor components of the overall contract.

2. The contract amount upon which the requirements set forth in paragraph (1) of Section VI is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. The contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the contracting agency has assured that each subcontract is

evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.

5. The 30% self-performance requirement of paragraph (1) is not applicable to design-build contracts; however, contracting agencies may establish their own self-performance requirements.

## **VII. SAFETY: ACCIDENT PREVENTION**

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704).

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C.3704).

## **VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS**

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, Form FHWA-1022 shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined under this title or imprisoned not more than 5 years or both."

#### **IX. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT**

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

By submission of this bid/proposal or the execution of this contract, or subcontract, as appropriate, the bidder, proposer, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any person who is or will be utilized in the performance of this contract is not prohibited from receiving an award due to a violation of Section 508 of the Clean Water Act or Section 306 of the Clean Air Act.

2. That the contractor agrees to include or cause to be included the requirements of paragraph (1) of this Section X in every subcontract, and further agrees to take such action as the contracting agency may direct as a means of enforcing such requirements.

#### **X. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION**

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, consultant contracts or any other covered transaction requiring FHWA approval or that is estimated to cost \$25,000 or more – as defined in 2 CFR Parts 180 and 1200.

##### **1. Instructions for Certification – First Tier Participants:**

a. By signing and submitting this proposal, the prospective first tier participant is providing the certification set out below.

b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this

covered transaction. The prospective first tier participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective first tier participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.

c. The certification in this clause is a material representation of fact upon which reliance was placed when the contracting agency determined to enter into this transaction. If it is later determined that the prospective participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the contracting agency may terminate this transaction for cause of default.

d. The prospective first tier participant shall provide immediate written notice to the contracting agency to whom this proposal is submitted if any time the prospective first tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

e. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. "First Tier Covered Transactions" refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). "Lower Tier Covered Transactions" refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). "First Tier Participant" refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

f. The prospective first tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction.

g. The prospective first tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transactions," provided by the department or contracting agency, entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the \$25,000 threshold.

h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (<https://www.epls.gov/>), which is compiled by the General Services Administration.

i. Nothing contained in the foregoing shall be construed to require the establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of the prospective participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph (f) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

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## **2. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – First Tier Participants:**

a. The prospective first tier participant certifies to the best of its knowledge and belief, that it and its principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency;

(2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification; and

(4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

b. Where the prospective participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

## **2. Instructions for Certification - Lower Tier Participants:**

(Applicable to all subcontracts, purchase orders and other lower tier transactions requiring prior FHWA approval or estimated to cost \$25,000 or more - 2 CFR Parts 180 and 1200)

a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which

this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations. "First Tier Covered Transactions" refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). "Lower Tier Covered Transactions" refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). "First Tier Participant" refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the \$25,000 threshold.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (<https://www.epls.gov/>), which is compiled by the General Services Administration.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the

department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

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**Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Participants:**

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

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**XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING**

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts which exceed \$100,000 (49 CFR 20).

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

3. The prospective participant also agrees by submitting its bid or proposal that the participant shall require that the language of this certification be included in all lower tier subcontracts, which exceed \$100,000 and that all such recipients shall certify and disclose accordingly.

### 7-1.50C Female and Minority Goals

To comply with Section II, "Nondiscrimination," of "Required Contract Provisions Federal-Aid Construction Contracts," the Department is including in Section 7-1.50C, "Female and Minority Goals," female and minority utilization goals for Federal-aid construction contracts and subcontracts that exceed \$10,000.

The nationwide goal for female utilization is 6.9 percent.

The goals for minority utilization [45 Fed Reg 65984 (10/3/1980)] are as follows:

| Minority Utilization Goals |  | Goal<br>(Percent)                                   |
|----------------------------|--|---|
| Economic Area              |  |   |
| 174                        | Redding CA:<br>Non-SMSA Counties:<br>CA Lassen; CA Modoc; CA Plumas; CA Shasta; CA Siskiyou; CA Tehama   | 6.8   |
| 175                        | Eureka, CA<br>Non-SMSA Counties:<br>CA Del Norte; CA Humboldt; CA Trinity  | 6.6   |
| 176                        | San Francisco-Oakland-San Jose, CA:<br>SMSA Counties:<br>7120 Salinas-Seaside-Monterey, CA<br>CA Monterey<br>7360 San Francisco-Oakland<br>CA Alameda; CA Contra Costa; CA Marin; CA San Francisco; CA San Mateo<br>7400 San Jose, CA<br>CA Santa Clara, CA<br>7485 Santa Cruz, CA<br>CA Santa Cruz<br>7500 Santa Rosa<br>CA Sonoma<br>8720 Vallejo-Fairfield-Napa, CA<br>CA Napa; CA Solano<br>Non-SMSA Counties:<br>CA Lake; CA Mendocino; CA San Benito | 28.9<br>25.6<br>19.6<br>14.9<br>9.1<br>17.1<br>23.2 |
| 177                        | Sacramento, CA:<br>SMSA Counties:<br>6920 Sacramento, CA<br>CA Placer; CA Sacramento; CA Yolo<br>Non-SMSA Counties<br>CA Butte; CA Colusa; CA El Dorado; CA Glenn; CA Nevada; CA Sierra; CA Sutter; CA Yuba  | 16.1<br>14.3  |
| 178                        | Stockton-Modesto, CA:<br>SMSA Counties:<br>5170 Modesto, CA<br>CA Stanislaus<br>8120 Stockton, CA<br>CA San Joaquin<br>Non-SMSA Counties<br>CA Alpine; CA Amador; CA Calaveras; CA Mariposa; CA Merced; CA Toulumne  | 12.3<br>24.3<br>19.8                                |
| 179                        | Fresno-Bakersfield, CA<br>SMSA Counties:<br>0680 Bakersfield, CA<br>CA Kern<br>2840 Fresno, CA<br>CA Fresno<br>Non-SMSA Counties:<br>CA Kings; CA Madera; CA Tulare  | 19.1<br>26.1<br>23.6                                |
| 180                        | Los Angeles, CA:<br>SMSA Counties:   |   |

|     |  |      |
|-----|--|------|
|     | 0360 Anaheim-Santa Ana-Garden Grove, CA<br>CA Orange                         | 11.9 |
|     | 4480 Los Angeles-Long Beach, CA<br>CA Los Angeles                            | 28.3 |
|     | 6000 Oxnard-Simi Valley-Ventura, CA<br>CA Ventura                            | 21.5 |
|     | 6780 Riverside-San Bernardino-Ontario, CA<br>CA Riverside; CA San Bernardino | 19.0 |
|     | 7480 Santa Barbara-Santa Maria-Lompoc, CA<br>CA Santa Barbara                | 19.7 |
|     | Non-SMSA Counties<br>CA Inyo; CA Mono; CA San Luis Obispo                    | 24.6 |
| 181 | San Diego, CA:<br>SMSA Counties  |      |
|     | 7320 San Diego, CA<br>CA San Diego   | 16.9 |
|     | Non-SMSA Counties<br>CA Imperial   | 18.2 |

For each July during which work is performed under the contract, you and each non-material-supplier subcontractor with a subcontract of \$10,000 or more must complete Form FHWA PR-1391 (Appendix C to 23 CFR 230). Submit the forms by August 15.

#### **7-1.50D Training**

Section 7-1.50D, "Training," applies if a number of trainees or apprentices is specified in the special provisions.

As part of your equal opportunity affirmative action program, provide on-the-job training to develop full journeymen in the types of trades or job classifications involved.

You have primary responsibility for meeting this training requirement.

If you subcontract a contract part, determine how many trainees or apprentices are to be trained by the subcontractor.

Include these training requirements in your subcontract.

Where feasible, 25 percent of apprentices or trainees in each occupation must be in their 1st year of apprenticeship or training.

Distribute the number of apprentices or trainees among the work classifications on the basis of your needs and the availability of journeymen in the various classifications within a reasonable recruitment area.

Before starting work, submit to the Department:

1. Number of apprentices or trainees to be trained for each classification
2. Training program to be used
3. Training starting date for each classification

Obtain the Department's approval for this submitted information before you start work. The Department credits you for each apprentice or trainee you employ on the work who is currently enrolled or becomes enrolled in an approved program.

The primary objective of Section 7-1.50D, "Training," is to train and upgrade minorities and women toward journeymen status. Make every effort to enroll minority and women apprentices or trainees, such as conducting systematic and direct recruitment through public and private sources likely to yield minority and women apprentices or trainees, to the extent they are available within a reasonable recruitment area. Show that you have made the efforts. In making these efforts, do not discriminate against any applicant for training.

Do not employ as an apprentice or trainee an employee:

1. In any classification in which the employee has successfully completed a training course leading to journeyman status or in which the employee has been employed as a journeyman
2. Who is not registered in a program approved by the US Department of Labor, Bureau of Apprenticeship and Training

Ask the employee if the employee has successfully completed a training course leading to journeyman status or has been employed as a journeyman. Your records must show the employee's answers to the questions.





**Replace Section 8 with:**  
**SECTION 8 PROSECUTION AND PROGRESS**

**8-1.01 (BLANK)**

**8-1.02 ASSIGNMENT**

No third-party agreement relieves you or your surety of your responsibility to complete the work. Do not sell, transfer, or otherwise dispose of any contract part without prior written consent from the Department.

If you assign the right to receive contract payments, the Department accepts the assignment upon the Engineer's receipt of a notice. Assigned payments remain subject to deductions and withholds described in the contract. The Department may use withheld payments for work completion whether payments are assigned or not.

**8-1.025 PRECONSTRUCTION CONFERENCE**

Attend a preconstruction conference with key personnel, including your assigned representative, at a time and location determined by the Engineer. Submit documents as required before the preconstruction conference. You may begin work before the preconstruction conference.

Be prepared to discuss the following topics and documents:

| Topics  | Document  |
|---|---|
| Potential claim and dispute resolution            | Potential claim forms                                       |
| Contractor's representation                       | Assignment of Contractor's representative                   |
| DBE and DVBE                                      | Final utilization reports                                   |
| Equipment   | Equipment list  |
| Labor compliance and equal employment opportunity | Job site posters and benefit and payroll reports            |
| Material inspection                               | Notice of Materials to be Used                              |
| Materials on hand                                 | Request for Payment for Materials on Hand                   |
| Measurements                                      | --  |
| Partnering  | Field Guide to Partnering on Caltrans Construction Projects |
| Quality control                                   | QC plans  |
| Safety  | Injury and Illness Prevention Program and job site posters  |
| Schedule  | Baseline schedule and Weekly Statement of Working Days      |
| Subcontracting                                    | Subcontracting Request                                      |
| Surveying   | Survey Request  |
| Traffic control                                   | Traffic contingency plan and traffic control plans          |
| Utility work                                      | --  |
| Weight limitations                                | --  |
| Water pollution control                           | SWPPP or WPCP   |
| Work restrictions                                 | PLACs   |
| Working drawings                                  | --  |

**8-1.03 BEGINNING OF WORK**

Begin work within 15 days after receiving notice that the contract has been approved by the Attorney General or the attorney appointed and authorized to represent the Department. Submit a written notice 72 hours before beginning work. If the project has more than one location of work, submit a separate notice for each location.

You may begin work before receiving the notice of contract approval if you:

1. Deliver the signed contract, bonds, and evidence of insurance to the Department
2. Submit 72-hour notice
3. Obtain an encroachment permit from the Department
4. Are authorized by the Department to begin
5. Perform work at your own risk
6. Perform work under the contract

The Engineer does not count working days for days worked before contract approval.

If the contract is approved, work already performed that complies with the contract is authorized.

If the contract does not get approved, leave the job site in a neat condition. If a facility has been changed, restore it to its former or equivalent condition at your expense.

The Department does not adjust time for beginning before the approval date.

#### 8-1.04 PROGRESS SCHEDULE

##### 8-1.04A General

Reserved

##### 8-1.04B Critical Path Method Schedule

The following definitions apply to critical path method schedules:

**activity:** Task, event, or other project element on a schedule that contributes to completing the project.

Activities have a description, start date, finish date, duration, and one or more logic ties.

**baseline schedule:** The initial schedule showing the original work plan beginning on the date of contract approval. This schedule shows no completed work to date and no negative float or negative lag to any activity.

**controlling activity:** Construction activity that extends the scheduled completion date if delayed.

**critical path:** Longest continuous chain of activities for the project that has the least amount of total float of all chains. In general, a delay on the critical path extends the scheduled completion date.

**critical path method (CPM):** Network based planning technique using activity durations and relationships between activities to calculate a schedule for the entire project.

**revised schedule:** Schedule that incorporates a proposed or past change to logic or activity durations.

**scheduled completion date:** Planned project completion date shown on the current schedule.

**updated schedule:** Current schedule developed from the accepted baseline and any subsequent accepted updated or revised schedules through regular monthly review to incorporate actual past progress.

Before or at the preconstruction conference, submit a CPM baseline schedule.

Submit a monthly updated schedule that includes the status of work completed to date and the work yet to be performed as planned.

On each schedule, show:

1. Planned and actual start and completion date of each work activity, including applicable:
  - 1.1. Submittal development
  - 1.2. Submittal review and approval
  - 1.3. Material procurement
  - 1.4. Contract milestones and constraints
  - 1.5. Equipment and plant setup
  - 1.6. Interfaces with outside entities
  - 1.7. Erection and removal of falsework and shoring
  - 1.8. Test periods
  - 1.9. Major traffic stage change
  - 1.10. Final cleanup
2. Order that you propose to prosecute the work
3. Logical links between the time-scaled work activities
4. All controlling activities
5. Legible description of each activity
6. At least one predecessor and one successor to each activity, except for project start and project end milestones
7. Duration of not less than one working day for each activity
8. Start milestone date as the contract approval date

You may include changes on updated schedules that do not alter the critical path or extend the schedule completion date compared to the current schedule. Changes may include:

1. Adding or deleting activities
2. Changing activity constraints
3. Changing durations
4. Changing logic

If any proposed change in planned work results in altering the critical path or extending the scheduled completion date, submit a revised schedule within 15 days of the proposed change.

For each schedule submittal:

1. Submit a plotted original, time-scaled network diagram on a sheet of at least 8.5" x 11" with a title block and timeline
2. If a computer program is used to make the schedule, submit a read-only compact disc or diskette containing the schedule data. Label the compact disc or diskette with:
  - 2.1. Contract number
  - 2.2. CPM schedule number and date produced
  - 2.3. File name

If there is no contract item for progress schedule (critical path method), full compensation for this work is included in the contract prices paid for the items of work involved, and no additional compensation will be allowed therefor.

## **8-1.05 TEMPORARY SUSPENSION OF WORK**

### **8-1.05A General**

The Engineer may suspend work wholly or in part due to any of the following:

1. Conditions are unsuitable for work progress.
2. You fail to do any of the following:
  - 2.1. Fulfill the Engineer's orders.
  - 2.2. Fulfill a contract part.
  - 2.3. Perform weather-dependent work when conditions are favorable so that weather-related unsuitable conditions are avoided or do not occur.

Upon the Engineer's written order of suspension, suspend work immediately. Provide for public safety and a smooth and unobstructed passageway through the work zone during the suspension as specified in Sections 7-1.08, "Public Convenience," and 7-1.09, "Public Safety." Resume work when ordered.

### **8-1.05B Suspensions Unrelated to Contractor Performance**

For a suspension unrelated to your performance, providing for a smooth and unobstructed passageway through the work during the suspension will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

The days during a suspension unrelated to your performance are non-working days.

### **8-1.05C Suspensions Related to Contractor Performance**

For a suspension related to your performance, the Department may provide for a smooth and unobstructed passageway through the work during the suspension and deduct the cost from payments.

The days during a suspension related to your performance are working days.

## **8-1.06 TIME OF COMPLETION**

The time to complete the work is specified in the special provisions.

The Engineer issues a Weekly Statement of Working Days by the end of the following week unless the contract is suspended for reasons unrelated to your performance.

The Weekly Statement of Working Days shows:

1. Working days and non-working days during the reporting week
2. Time adjustments
3. Work completion date computations, including working days remaining
4. Controlling activities

You may protest a Weekly Statement of Working Days.

## **8-1.07 LIQUIDATED DAMAGES**

### **8-1.07A General**

The Department specifies liquidated damages (Pub Cont Code § 10226). Liquidated damages, if any, accrue starting on the 1st day after the expiration of the working days through the day of contract acceptance except as specified in Sections 8-1.07B, "Failure to Complete Work Parts within Specified Times," and 8-1.07C, "Failure to Complete Work Parts by Specified Dates."

The Department withholds liquidated damages before the accrual date if the anticipated liquidated damages may exceed the value of the remaining work.

Liquidated damages for all work, except plant establishment, are:

| Liquidated Damages |               |                            |
|--------------------|---------------|----------------------------|
| Total Bid          |               | Liquidated Damages per Day |
| From over          | To            |                            |
| \$0                | \$50,000      | \$1,200                    |
| \$50,000           | \$120,000     | \$1,500                    |
| \$120,000          | \$1,000,000   | \$1,900                    |
| \$1,000,000        | \$5,000,000   | \$3,000                    |
| \$5,000,000        | \$10,000,000  | \$5,400                    |
| \$10,000,000       | \$30,000,000  | \$8,300                    |
| \$30,000,000       | \$100,000,000 | \$10,500                   |
| \$100,000,000      | \$250,000,000 | \$28,500                   |

If all work, except plant establishment, is complete and the total number of working days has expired, liquidated damages are \$950 per day.

### **8-1.07B Failure to Complete Work Parts within Specified Times**

The Department may deduct specified damages from payments for each day in completing a work part beyond the time specified for completing the work part.

Damages for untimely completion of work parts may not be equal to the daily amount specified as liquidated damages for the project as a whole, but the Department does not simultaneously assess damages for untimely completion of work parts and for the whole work.

Damages accrue starting the 1st day after a work part exceeds the specified time through the day the specified work part is complete.

### **8-1.07C Failure to Complete Work Parts by Specified Dates**

The Department may deduct specified damages from payments for each day in completing a work part beyond the specified completion date for the work part.

Damages for untimely work part completion may not be equal to the daily amount specified as liquidated damages for the project as a whole, but the Department does not simultaneously assess damages for untimely work part completion and the whole work.

Damages accrue starting the 1st day after an unmet completion date through the day the work part is complete.

### **8-1.07D Director Days**

If the work is not completed within the working days, the Director may grant director days if it serves the State's best interest.

By granting director days, the Director adds working days to the contract. The Director may either grant enough days to eliminate the liquidated damages or fewer. In the latter case, the Department deducts liquidated damages for the remaining overrun in contract time. The Director may deduct the Department's engineering, inspection, and overhead costs incurred during the period of extension granted as director days.

## **8-1.08 TERMINATION OF CONTROL**

The Department may terminate your control of the work for failure to do any of the following (Pub Cont Code § 10253):

1. Supply an adequate workforce
2. Supply material as described
3. Pay subcontractors (Pub Cont Code §10262)

4. Prosecute the work as described in the contract

The Department may also terminate your control for failure to maintain insurance coverage.

For a Federal-aid contract, the Department may terminate your control of the work for failure to include "Required Contract Provisions, Federal-Aid Construction Contracts" in subcontracts.

The Department gives you and your surety notice at least 5 days before terminating control. The notice describes the failures and the time allowed to remedy the failures. If failures are not remedied within the time provided, the Department takes control of the work.

The Department may complete the work if the Department terminates your control or you abandon the project (Pub Cont Code § 10255). The Department determines the unpaid balance under Pub Cont Code § 10258 and the contract.

At any time before final payment of all claims, the Department may convert a termination of control to a termination of contract.

## **8-1.09 DELAYS**

### **8-1.09A General**

An excusable delay is a delay of a controlling activity beyond your control, not foreseeable when the work began such as:

1. Change in the work
2. Department action that is not part of the contract
3. Presence of an underground utility main not described in the contract or in a location different from that specified
4. Described facility reconstruction not reconstructed as described, by the utility owner by the date specified, unless the reconstruction is solely for your convenience
5. Department's failure to obtain timely access to the right-of-way
6. Department's failure to perform an action in the time specified

A critical delay is a delay that extends the schedule completion date.

To request a delay-related time or payment adjustment, submit an RFI.

### **8-1.09B Time Adjustments**

For an excusable critical delay, the Department may make a time adjustment. The Engineer uses information from the schedule to evaluate requests for time adjustments.

If requesting an adjustment, submit a revised schedule showing the delay's effect on the controlling activity. If the delay has:

1. Occurred, submit records of dates and what work was performed during the delayed activity
2. Not occurred, submit the expected dates or duration of the delayed activity

If the Engineer requests, update the schedule to the last working day before the start of the delay.

### **8-1.09C Payment Adjustments**

The Department may make a payment adjustment for an excusable delay that affects your costs.

Only losses for idle equipment, idle workers, and equipment moving or transporting are eligible for delay-related payment adjustments.

The Engineer determines payment for idle time of equipment in the same manner as determinations are made for equipment used in the performance of force account work under Section 9-1.03, "Force Account," with the following exceptions:

1. Delay factor in the Labor Surcharge and Equipment Rental Rates applies to each equipment rental rate.
2. Daily number of payable hours equals the normal working hours during the delay, not to exceed 8 hours per day.
3. Delay days exclude non-working days.
4. Markups are not added.

The Engineer determines payment adjustment for idle workers under Section 9-1.03B, "Labor," but does not add markups.

The Engineer includes costs due to necessary extra equipment moving or transporting.

#### **8-1.10 (BLANK)**

#### **8-1.11 TERMINATION OF CONTRACT**

##### **8-1.11A General**

The Director may terminate the contract if it serves the State's best interest. The Department issues you a written notice, implements the termination, and pays you.

##### **8-1.11B Relief from Responsibility for Work**

On receiving a termination notice:

1. Stop work
2. Notify subcontractors and suppliers of the contract termination and stop contract-related work
3. Perform the Engineer-ordered work to secure the job site for termination
4. Remove equipment
5. If authorized, settle termination-related claims and liabilities involving subcontractors and suppliers; assign to the Department the rights, titles, or interests held by you with respect to these parties

##### **8-1.11C Responsibility for Materials**

On receiving a termination notice, protect unused material until:

1. You submit an inventory of materials already produced, purchased, or ordered but not yet used; include the location of the material.
2. The Engineer identifies materials that will be retained by the Department. Submit bills of sales or other records of material title.
3. The Engineer confirms that unused materials paid by progress payment and materials furnished by the State have been delivered and stored as ordered.
4. Titles are transferred for materials purchased by the Department.

Dispose of materials that will not be retained by the Department.

##### **8-1.11D Contract Acceptance after Termination**

The Engineer recommends contract acceptance after determining completion of:

1. Contract work ordered to be completed before termination
2. Other work ordered to secure the project before termination
3. Material delivery and title transfer

The Department pays you under Section 9-1.08, "Payment After Contract Acceptance."

##### **8-1.11E Payment Adjustment for Termination**

If the Department issues a termination notice, the Engineer determines payment for termination based on the following:

1. Direct cost for the work:
  - 1.1. Including mobilization, demobilization, securing the job site for termination, and losses from the sale of materials
  - 1.2. Not including the cost of materials you keep, profit realized from the sale of materials, the cost of material damaged by an occurrence as defined in Section 7-1.165, "Damage by Storm, Flood, Tsunami or Earthquake," and other credits.
2. Cost of remedial work, as estimated by the Engineer, is not reimbursed.
3. Allowance for profit not to exceed 4 percent of the cost of the work. Prove a likelihood of having made a profit had the contract not been terminated.
4. Material handling costs for material returned to the vendor or disposed of as ordered.

- Termination of the contract does not relieve the surety of its obligation for any just claims arising out of the work performed.

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- 3.1. Use securely attached metal shims or grout
  - 3.2. Do not use wedges to shim the supports
  - 3.3. Do not use shim material in excess of 3 inches
4. Install mechanical indicating elements level, plumb, and rigidly mounted on the concrete undersupports
  5. For a hopper scale, rigidly attach hopper scale lever systems and mechanical indicating elements so no weight is lost from bending or support distortion

Each scale used to determine material payment quantities must be operated by a licensed weighmaster (Bus & Prof Code § 12700 et seq.).

Submit a public weighmaster's certificate or certified daily summary weigh sheets for each weighed material quantity. The Department may witness material weighing and check and compile the daily scale weight record.

Each vehicle operator must obtain weight or load slips from the weighmaster. Submit these records at the delivery point.

#### **9-1.01B(3) Procedures**

Daily, weigh empty vehicles used to haul material paid for by weight. Each vehicle must have a legible identification mark. The Department may verify material weight by having an empty and loaded vehicle weighed on any scale the Engineer designates.

For imported topsoil measured by volume, soil amendment, and mulch:

1. Each vehicle must allow a ready and accurate contents determination
2. Unless vehicles are of uniform capacity, each vehicle must have a legible identification mark showing its volume capacity
3. Load vehicles to at least the volume capacity
4. Level vehicle loads on arrival at the delivery point

If determining a quantity paid on a volume basis is impractical or if you request and the Engineer authorizes the request, the Engineer weighs the material and converts the result to a volume measurement. The Engineer determines the conversion factors and, if you agree, adopts this method of measurement.

#### **9-1.01C Final Pay Items**

The Department shows a bid item quantity as a final pay item for payment purposes only. For a final pay item, accept payment based on the verified Bid Item List quantity, regardless of actual quantity used unless dimensions are changed by the Engineer.

#### **9-1.01D Quantities of Aggregate and Other Roadway Materials**

The Engineer determines the weight of aggregate and other roadway materials that are being paid for by weight as shown and does not include the deducted weight of water in their payment quantities.

| Material  | Quantity Determination  |
|---|---|
| Aggregate or other roadway material except as otherwise shown in this table | By deducting the weight of water in the material <sup>a</sup> in excess of 3 percent of the dry weight of the material from the weight of the material  |
| Imported borrow, imported topsoil, aggregate subbase                        | By deducting the weight of water in the material <sup>a</sup> in excess of 6 percent of the dry weight of the material from the weight of the material  |
| Straw   | By deducting the weight of water in the material <sup>a</sup> in excess of 15 percent of the dry weight of the material from the weight of the material |
| Fiber <sup>b</sup>  | Engineer does not deduct the weight of water  |
| Aggregate base and aggregate for cement treated bases                       | As specified in Section 26, "Aggregate Bases," and Section 27, "Cement Treated Bases"   |

NOTE: Percentage of water is determined by California Test 226.

<sup>a</sup>At the time of weighing

<sup>b</sup>Weight of water in the fiber<sup>a</sup> must not exceed 15 percent of the dry weight of the fiber.

### **9-1.02 SCOPE OF PAYMENT**

The Department pays you for furnishing the resources and activities required to complete the Contract work. The Department's payment is full compensation for furnishing the resources and activities, including:

1. Risk, loss, damage repair, or cost of whatever character arising from or relating to the work and performance of the work
2. PLACs and taxes

Full compensation for work specified in Sections 1 through 9 is included in the payment for the bid items involved unless:

1. Bid item for the work is shown on the verified Bid Item List
2. Work is specified as paid for as extra work

The Department does not pay for your loss, damage, repair, or extra costs of whatever character arising from or relating to the work that is a direct or indirect result of your choice of construction methods, materials, equipment, or manpower, unless specifically mandated by the Contract.

Payment is:

1. Full compensation for each bid item specified by the description and measurement unit shown on the verified Bid Item List
2. For the price bid for each bid item shown on the verified Bid Item List or as changed by change order with a specified price adjustment

If an alternative is described in the Contract, the Department pays based on the bid items for the details and specifications not described as an alternative.

The Department pays for work performed by change order based on one or a combination of the following:

1. Bid item prices
2. Force account
3. Agreed price
4. Specialist billing

If the Engineer chooses to pay for work performed by change order based on an agreed price, but you and the Engineer cannot agree on the price, the Department pays by force account.

If a portion of extra work is covered by bid items, the Department pays for this work as changed quantities in those items. The Department pays for the remaining portion of the extra work by force account or agreed price.

The Department pays 10 percent annual interest for unpaid and undisputed:

1. Progress payments
2. After-acceptance payment except for claims

For these payments, interest starts to accrue 30 days after the 1st working day following the 20th day of the month payment is due. For extra work bills not submitted within 7 days after performing the work as specified in 5-1.015E, "Extra Work Bills," interest starts to accrue 60 days after the 1st working day following the 20th day of the month payment is due.

The Department pays 6 percent annual interest for unpaid and undisputed claims. Interest starts to accrue 61 days after the Department accepts a claim statement.

The Department pays 6 percent annual interest for awards in arbitration (Civ Code § 3289).

If the amount of a deduction or withhold exceeds final payment, the Department invoices you for the difference, to be paid upon receipt.

### **9-1.03 FORCE ACCOUNT PAYMENT**

#### **9-1.03A General**

For work paid by force account, the Engineer compares the Department's records to your daily force account work report. When you and the Engineer agree on the contents of the daily force account work reports, the Engineer accepts the report and the Department pays for the work. If the records differ, the Department pays for the work based only on the information shown on the Department's records.

If a subcontractor performs work at force account, accept an additional 10 percent markup to the total cost of that work paid at force account, including markups specified in Section 9-1.03, as reimbursement for additional administrative costs.

The markups specified in labor, materials, and equipment include compensation for all delay costs, overhead costs, and profit.

If an item's payment is adjusted for work-character changes, the Department excludes your cost of determining the adjustment.

Payment for owner-operated labor and equipment is made at the market-priced invoice submitted.

#### **9-1.03B Labor**

Labor payment is full compensation for the cost of labor used in the direct performance of the work plus a 35 percent markup. Force account labor payment consists of:

1. Employer payment to the worker for:
  - 1.1. Basic hourly wage
  - 1.2. Health and welfare
  - 1.3. Pension
  - 1.4. Vacation
  - 1.5. Training
  - 1.6. Other State and federal recognized fringe benefit payments
2. Labor surcharge percentage in Labor Surcharge and Equipment Rental Rates current during the work paid at force account for:
  - 2.1. Workers' compensation insurance
  - 2.2. Social security
  - 2.3. Medicare
  - 2.4. Federal unemployment insurance
  - 2.5. State unemployment insurance
  - 2.6. State training taxes
3. Subsistence and travel allowances paid to the workers
4. Employer payment to supervisors, if authorized

The 35 percent markup consists of payment for all overhead costs related to labor but not designated as costs of labor used in the direct performance of the work including:

1. Home office overhead
2. Field office overhead
3. Bond costs
4. Profit
5. Labor liability insurance
6. Other fixed or administrative costs that are not costs of labor used in the direct performance of the work

#### **9-1.03C Materials**

Material payment is full compensation for materials you furnish and use in the work. The Engineer determines the cost based on the material purchase price, including delivery charges, except:

1. A 15 percent markup is added.
2. Supplier discounts are subtracted whether you took them or not.
3. If the Engineer believes the material purchase prices are excessive, the Department pays the lowest current wholesale price for a similar material quantity.
4. If you procured the materials from a source you wholly or partially own, the determined cost is based on the lower of the:
  - 4.1. Price paid by the purchaser for similar materials from that source on Contract items
  - 4.2. Current wholesale price for those materials

5. If you do not submit a material cost record within 30 days of billing, the determined cost is based on the lowest wholesale price:

- 5.1. During that period
- 5.2. In the quantities used

### **9-1.03D Equipment Rental**

#### **9-1.03D(1) General**

Equipment rental payment is full compensation for:

1. Rental equipment costs, including moving rental equipment to and from the site of work performed by change order using its own power.
2. Transport equipment costs for rental equipment that cannot be transported economically using its own power. No payment is made during transport for the transported equipment.
3. 15 percent markup.

If you want to return the equipment to a location other than its original location, the payment to move the equipment must not exceed the cost of returning the equipment to its original location. If you use the equipment for work other than work paid by force account, the transportation cost is included in the other work.

Before moving or loading the equipment, obtain authorization for the equipment rental's original location.

The Engineer determines rental costs:

1. Using rates in Labor Surcharge and Equipment Rental Rates:
  - 1.1. By classifying equipment using manufacturer's ratings and manufacturer-approved changes.
  - 1.2. Current during the work paid by force account.
  - 1.3. Regardless of equipment ownership; but the Department uses the rental document rates or minimum rental cost terms if:
    - 1.3.1. Rented from equipment business you do not own.
    - 1.3.2. The Labor Surcharge and Equipment Rental Rates hourly rate is \$10.00 per hour or less.
2. Using rates established by the Engineer for equipment not listed in Labor Surcharge and Equipment Rental Rates. You may submit cost information that helps the Engineer establish the rental rate; but the Department uses the rental document rates or minimum rental cost terms if:
  - 2.1. Rented from equipment business you do not own.
  - 2.2. The Engineer establishes a rate of \$10.00 per hour or less.
3. Using rates for transport equipment not exceeding the hourly rates charged by established haulers.

Equipment rental rates include the cost of:

1. Fuel
2. Oil
3. Lubrication
4. Supplies
5. Small tools that are not consumed by use
6. Necessary attachments
7. Repairs and maintenance
8. Depreciation
9. Storage
10. Insurance
11. Incidentals

The Department pays for small tools consumed by use. The Engineer determines payment for small tools consumed by use based on Contractor-submitted invoices.

### **9-1.03D(2) Equipment On the Job Site**

For equipment on the job site at the time required to perform work paid by force account, the time paid is the time:

1. To move the equipment to the location of work paid by force account plus an equal amount of time to move the equipment to another location on the job site when the work paid by force account is completed
2. To load and unload equipment
3. Equipment is operated to perform work paid by force account and:
  - 3.1. Hourly rates are paid in 1/2-hour increments
  - 3.2. Daily rates are paid in 1/2-day increments

When rented equipment on the job site is used to perform work at force account not required by the original contract work, the Engineer may authorize rates in excess of those in Labor Surcharge and Equipment Rental Rates if:

1. You submit a request to use rented equipment
2. Equipment is not available from your owned equipment fleet or from your subcontractors
3. Rented equipment is from an independent rental company
4. Proposed equipment rental rate is reasonable
5. Engineer authorizes the equipment source and the rental rate before you use the equipment

The Department pays for fuel consumed during operation of rented equipment not included in the invoiced rental rate.

### **9-1.03D(3) Equipment Not On the Job Site Required for Original Contract Work**

For equipment not on the job site at the time required to perform work paid by force account and required for original Contract work, the time paid is the time the equipment is operated to perform work paid by force account and the time to move the equipment to a location on the job site when the work paid by force account is completed.

The minimum total time paid is:

1. 1 day if daily rates are paid
2. 8 hours if hourly rates are paid

If daily rates are recorded, equipment:

1. Idled is paid as 1/2 day
2. Operated 4 hours or less is paid as 1/2 day
3. Operated 4 hours or more is paid as 1 day

If the minimum total time exceeds 8 hours and if hourly rates are listed, the Department rounds up hours operated to the nearest 1/2-hour increment and pays based on the following table. The table does not apply when equipment is not operated due to breakdowns; in which case rental hours are the hours the equipment was operated.

**Equipment Rental Hours**

| Hours operated | Hours paid |
|----------------|------------|
| 0.0            | 4.00       |
| 0.5            | 4.25       |
| 1.0            | 4.50       |
| 1.5            | 4.75       |
| 2.0            | 5.00       |
| 2.5            | 5.25       |
| 3.0            | 5.50       |
| 3.5            | 5.75       |
| 4.0            | 6.00       |
| 4.5            | 6.25       |
| 5.0            | 6.50       |

|      |            |
|------|------------|
| 5.5  | 6.75       |
| 6.0  | 7.00       |
| 6.5  | 7.25       |
| 7.0  | 7.5        |
| 7.5  | 7.75       |
| >8.0 | hours used |

#### **9-1.03D(4) Equipment Not On the Job Site Not Required for Original Contract Work**

For equipment not on the job site at the time required to perform work paid by force account and not required for original Contract work, the time paid is the time:

1. To move the equipment to the location of work paid by force account plus an equal amount of time to return the equipment to its source when the work paid by force account is completed
2. To load and unload equipment
3. Equipment is operated to perform work paid by force account

For this equipment, the Engineer may authorize rates in excess of those in Labor Surcharge and Equipment Rental Rates subject to the following:

1. Equipment is not available from your normal sources or from one of your subcontractors
2. Proposed equipment rental rate is reasonable
3. Engineer authorizes the equipment source and the rental rate before you use the equipment

#### **9-1.03D(5) Non-Owner-Operated Dump Truck Rental**

Submit the rental rate for non-owner-operated dump truck rental. The Engineer determines the payment rate. Payment for non-owner-operated dump truck rental is for the cost of renting a dump truck, including its driver. For the purpose of markup payment only, the non-owner-operated dump truck is rental equipment and the owner is a subcontractor.

### **9-1.04 EXTRA WORK PERFORMED BY SPECIALISTS**

If the Engineer determines that you or your subcontractors are not capable of performing specialty extra work, a specialist may be used. Itemize the labor, material, and equipment rental costs unless it is not the special service industry's established practice to provide itemization; in which case, the Engineer accepts current market-priced invoices for the work.

The Engineer may accept an invoice as a specialist billing for work performed at an off-job site manufacturing plant or machine shop.

The Engineer determines the cost based on the specialist invoice price minus any available or offered discounts plus a 10 percent markup.

### **9-1.05 CHANGED QUANTITY PAYMENT ADJUSTMENTS**

#### **9-1.05A General**

The unit prices specified in Section 9-1.05 are adjusted under Section 9-1.03, "Force Account."

#### **9-1.05B Increases of More Than 25 Percent**

If the total bid item quantity exceeds 125 percent of the quantity shown on the verified Bid Item List and if no approved Contract Change Order addresses payment for the quantity exceeding 125 percent, the Engineer may adjust the unit price for the excess quantity under Section 9-1.03, "Force Account," or the following:

1. The adjustment is the difference between the unit price and the unit cost of the total item pay quantity.
2. In determining the unit cost, the Engineer excludes the item's fixed costs. You have recovered the fixed costs in the payment for 125 percent shown on the verified Bid Item List.
3. After excluding fixed costs, the Engineer determines the item unit cost under Section 9-1.03, "Force Account."

If the payment for the number of units of a bid item in excess of 125 percent of the verified Bid Item List is less than \$5,000 at the unit price, the Engineer may not adjust the unit price unless you request it.

### **9-1.05C Decreases of More Than 25 Percent**

If the total item pay quantity is less than 75 percent of the quantity shown on the verified Bid Item List and if no approved Contract Change Order addresses payment for the quantity less than 75 percent, you may request a unit price adjustment. The Engineer may adjust the unit price for the decreased quantity under Section 9-1.03, "Force Account" or the following:

1. The adjustment is the difference between the unit price and the unit cost of the total pay quantity.
2. In determining the unit cost, the Engineer includes the item's fixed costs.
3. After including fixed costs, the Engineer determines the item unit cost under Section 9-1.03, "Force Account."

The Department does not pay more than 75 percent of the item total in the verified Bid Item List.

### **9-1.05D Eliminated Items**

If the Engineer eliminates an item, the Department pays your costs incurred before the Engineer's elimination notification date.

If you order authorized material for an eliminated item before the notification date and the order cannot be canceled, either of the following occurs:

1. If the material is returnable to the vendor, the Engineer orders you to return the material and the Department pays your handling costs and vendor charges.
2. The Department pays your cost for the material and its handling and becomes the material owner.

The Engineer determines the payment for the eliminated bid item under Section 9-1.03, "Force Account."

## **9-1.06 WORK-CHARACTER CHANGES**

The Department adjusts a bid item unit price based on the difference between the cost to perform the work as planned and the cost to perform the work as changed. The Engineer determines the payment adjustment under Section 9-1.03, "Force Account." The Department adjusts payment for only the work portion that changed in character.

## **9-1.07 PROGRESS PAYMENTS**

### **9-1.07A General**

The Department pays you based on Engineer-prepared monthly progress estimates. Each estimate reflects:

1. Total work completed during the pay period
2. Extra work bills if:
  - 2.1. Submitted by the 15th of a month
  - 2.2. Approved by the 20th of a month
3. Amount for materials on hand
4. Amount earned for mobilization
5. Deductions
6. Withholds
7. Resolved potential claims
8. Payment adjustments

Submit certification stating the work complies with the QC procedures. The Engineer does not process a progress estimate without a signed certification.

You may protest a progress payment.

### **9-1.07B Schedule of Values**

Section 9-1.07B applies to a lump sum bid item for which a schedule of values is specified to be submitted.

The sum of the amounts for the work units listed in the schedule of values must equal the lump sum price bid for the bid item.

Obtain authorization of a schedule of values before you perform work shown on the schedule. The Department does not process a progress payment for the bid item without an authorized schedule of values.

Accept progress payments for overhead, profit, bond costs, and other fixed or administrative costs as distributed proportionally among the items listed except that for a contract with a bid item for mobilization, accept progress payments for bond costs as included in the mobilization bid item.

For changed quantities of the work units listed, the Department adjusts payments in the same manner as specified for changed quantities of bid items under Section 9-1.05, "Changed Quantity Payment Adjustments."

#### **9-1.07C Materials On Hand**

A material on hand but not incorporated into the work is eligible for progress payment if:

1. Listed in a special provision as eligible and is in compliance with other Contract parts
2. Purchased
3. An invoice is submitted
4. Stored within the State and you submit evidence that the stored material is subject to the Department's control
5. Requested on the Department-furnished form

#### **9-1.07D Mobilization**

Mobilization is eligible for partial payments if the Contract includes a bid item for mobilization. The Department makes the partial payments under Pub Cont Code § 10264. If the Contract does not include a mobilization bid item, mobilization is included in the payment for the various bid items.

The Department pays the item total for mobilization in excess of 10 percent of the total bid in the 1st payment after Contract acceptance.

#### **9-1.07E Withholds**

##### **9-1.07E(1) General**

The Department may withhold payment for noncompliance.

The Department returns the noncompliance withhold in the progress payment following correction of noncompliance.

Withholds are not retentions under Pub Cont Code § 7107 and do not accrue interest under Pub Cont Code § 10261.5.

Withholds are cumulative and independent of deductions.

Section 9-1.07E does not include all withholds that may be taken; the Department may withhold other payments as specified.

##### **9-1.07E(2) Progress Withholds**

The Department withholds 10 percent of a partial payment for noncompliant progress. Noncompliant progress occurs when:

1. Total days to date exceed 75 percent of the revised Contract working days
2. Percent of working days elapsed exceeds the percent of value of work completed by more than 15 percent

The Engineer determines the percent of working days elapsed by dividing the total days to date by the revised Contract working days and converting the quotient to a percentage.

The Engineer determines the percent of value of work completed by summing payments made to date and the amount due on the current progress estimate, dividing this sum by the current total estimated value of the work, and converting the quotient to a percentage. These amounts are shown on the Progress Payment Voucher.

When the percent of working days elapsed minus the percent of value of work completed is less than or equal to 15 percent, the Department returns the withhold in the next progress payment.

##### **9-1.07E(3) Performance Failure Withholds**

During each estimate period you fail to comply with a Contract part, including submittal of a document as specified, the Department withholds a part of the progress payment. The documents include QC plans, schedules, traffic control plans, and water pollution control submittals.

For 1 performance failure, the Department withholds 25 percent of the progress payment but does not withhold more than 10 percent of the total bid.

For multiple performance failures, the Department withholds 100 percent of the progress payment but does not withhold more than 10 percent of the total bid.



#### **9-1.07E(4) Stop Notice Withholds**

The Department may withhold payments to cover claims filed under Civ Code § 3179 et seq.

Stop notice information may be obtained from the Office of External Accounts Payable, Division of Accounting.

#### **9-1.07E(5) Penalty Withholds**

Penalties include fines and damages that are proposed, assessed, or levied against you or the Department by a governmental agency or private lawsuit. Penalties are also payments made or costs incurred in settling alleged violations of federal, state, or local laws, regulations, requirements, or PLACs. The cost incurred may include the amount spent for mitigation or correcting a violation.

If you or the Department is assessed a penalty, the Department may withhold the penalty amount until the penalty disposition has been resolved. The Department may withhold penalty funds without notifying you.

Instead of the withhold, you may provide a bond equal to the highest estimated liability for any disputed penalties proposed.

#### **9-1.07E(6)–9-1.07E(10) Reserved**

#### **9-1.07F Retentions**

The Department does not retain moneys from progress payments due to the Contractor for work performed (Pub Cont Code § 7202).

#### **9-1.07G–9-1.07K Reserved**

### **9-1.08 PAYMENT AFTER CONTRACT ACCEPTANCE**

#### **9-1.08A General**

Reserved

#### **9-1.08B Payment Before Final Estimate**

After Contract acceptance, the Department pays you based on the Engineer-prepared estimate that includes withholds and the balance due after deduction of previous payments.

#### **9-1.08C Proposed Final Estimate**

The Engineer estimates the amount of work completed and shows the amount payable in a proposed final estimate based on:

1. Contract items
2. Payment adjustments
3. Work paid by force account or agreed price
4. Extra work
5. Deductions

Submit either a written final estimate acceptance or a claim statement no later than the 30th day after receiving the proposed final estimate. Evidence of the Contractor's receipt of the final estimate and the Engineer's receipt of the Contractor's written acceptance or claim statement is a delivery service's proof of delivery or Engineer's written receipt if hand delivered.

If you claim that the final estimate is less than 90 percent of your total bid, the Department adjusts the final payment to cover your overhead. The adjustment is 10 percent of the difference between the total bid and the final estimate. The Department does not make this adjustment on a terminated contract.

#### **9-1.08D Final Payment and Claims**

##### **9-1.08D(1) General**

If you accept the proposed final estimate or do not submit a claim statement within 30 days of receiving the estimate, the Engineer furnishes the final estimate to you and the Department pays the amount due within 30 days. This final estimate and payment is conclusive except as specified in Sections 5-1.015, "Records," 6-1.075, "Guarantee," and 9-1.09, "Clerical Errors."

If you submit a claim statement within 30 days of receiving the Engineer's proposed final estimate, the Engineer furnishes a semifinal estimate to the Contractor and the Department pays the amount due within 30 days. The semifinal estimate is conclusive as to the amount of work completed and the amount payable except as affected by the claims or as specified in Sections 5-1.015, "Records," 6-1.075, "Guarantee," and 9-1.09, "Clerical Errors."

#### **9-1.08D(2) Claim Statement**

##### **9-1.08D(2)(a) General**

For each claim, submit a claim statement showing only the identification number that corresponds to the Full and Final Potential Claim Record and the final amount of additional payment requested except:

1. If the final amount of requested payment differs from the amount requested in the Full and Final Potential Claim Record
2. For a claim for quantities, withholds, deductions, liquidated damages, or change order bills
3. For an overhead claim

If the final amount of requested payment differs from the amount requested in the Full and Final Potential Claim Record, submit:

1. Identification number that corresponds to the Full and Final Potential Claim Record
2. Final amount of additional payment requested
3. Basis for the changed amount
4. Contract documentation that supports the changed amount
5. Statement of the reasons the Contract documentation supports the claim

The Engineer notifies you of an omission of or a disparity in the exclusive identification number. Within 15 days of the notification, correct the omission or disparity. If the omission or disparity is not resolved after the 15 days, the Engineer assigns a new number.

For a claim for quantities, withholds, deductions, or change order bills submit:

1. Final amount of additional payment requested
2. Enough detail to enable the Engineer to determine the basis and amounts of the additional payment requested

##### **9-1.08D(2)(b) Overhead Claims**

Include with an overhead claim:

1. Final amount of additional payment requested
2. Independent CPA audit report

Failure to submit the audit report with an overhead claim with the claim statement is a waiver of the overhead claim and operates as a bar to arbitration on the claim (Pub Cont Code § 10240.2).

The Department deducts an amount for field and home office overhead paid on added work from any claim for overhead. The value of the added work equals the value of the work completed minus the total bid. The home office overhead deduction equals 5 percent of the added work. The field office overhead deduction equals 5-1/2 percent of the added work.

If you intend to pursue a claim for reimbursement for field or home office overhead beyond that provided expressly by the Contract:

1. Notify the Engineer within 30 days of receipt of the proposed final estimate of your intent to seek reimbursement for specific overhead costs beyond that provided by the Contract
2. Specifically identify each claim and each date associated with each claim from which you seek reimbursement for specific overhead costs beyond that provided by the Contract
3. Timely submit all other claims
4. Within 30 days of receipt of the proposed final estimate, submit an audit report prepared by an independent CPA
  - 4.1. The audit report must show calculations with supporting documentation of actual home office and project field overhead costs

- 4.2. The calculations must specify the actual daily rates for both field and home office overhead for the entire duration of the project expressed as a rate per working day
- 4.3. The start and end dates of the actual project performance period, number of working days, overhead cost pools, and all allocation bases must be disclosed in the calculations of your actual field and home office overhead daily rates
- 4.4. Neither daily rate may include a markup for profit
5. Field overhead costs from which the daily rate is calculated must be:
  - 5.1. Allowable under 48 CFR 31
  - 5.2. Supported by reliable records
  - 5.3. Related solely to the project
  - 5.4. Incurred during the actual project performance period
  - 5.5. Comprised of only time-related field overhead costs
  - 5.6. Not a direct cost
6. Home office overhead costs from which the daily rate is calculated must be:
  - 6.1. Allowable under 48 CFR 31
  - 6.2. Supported by reliable records
  - 6.3. Incurred during the actual project performance period
  - 6.4. Comprised of only fixed home office overhead costs
  - 6.5. Not a direct cost

The actual rate of time-related overhead is subject to authorization by the Engineer.

The CPA's audit must be performed under the Attestation Standards published by the American Institute of Certified Public Accountants. The CPA's audit report must express an opinion whether or not your calculations of your actual field and home office overhead daily rates comply with Section 9-1.08D(2)(b), "Overhead Claims." The attest documentation prepared by the CPA in connection with the audit must be reproduced and submitted for review with the audit report.

The Department provides markups for all work paid by force account. Overhead for field and home office costs are included in the markups. Overhead claims in excess of Contract markups are not allowed under the Contract. If you seek reimbursement for costs not allowed under the Contract, the Department does not pay your cost of performing the independent CPA examination specified in section 9-1.08D(2)(b), "Overhead Claims," including preparation of the audit report.

#### **9-1.08D(2)(c) Declaration**

Submit a declaration that includes the following language with the claim statement:

I declare under penalty of perjury, according to the laws of the State of California, that the foregoing claims, with specific reference to the California False Claims Act (Govt Code § 12650 et seq.) and to the extent the project contains federal funding, the U.S. False Claims Act (31 USC § 3729 et seq.), are true and correct, and that this declaration was signed on \_\_\_\_\_(date)\_\_\_\_\_, 20\_\_ at \_\_\_\_\_, California.

#### **9-1.08D(2)(d) Waiver**

A claim is waived if:

1. Claim does not have a corresponding Full and Final Potential Claim Record identification number
2. Claim does not have the same nature, circumstances, and basis of claim as the corresponding Full and Final Potential Claim Record
3. Claim is not included in the claim statement
4. You do not comply with the claim procedures
5. You do not submit the declaration specified in 9-1.08D(2)(c), "Declaration"

#### **9-1.08D(3) Final Determination of Claims**

Failure to allow timely access to claim supporting data when requested waives the claim.

If the Engineer determines that a claim requires additional analysis, the Engineer schedules a board of review meeting. Meet with the board of review and make a presentation supporting the claim.

After claim review completion by the Engineer or board of review, the Department makes the final determination of claims and furnishes it to the Contractor.

After the determination, the Engineer furnishes a final estimate to the Contractor and the Department pays the amount due within 30 days. The final estimate is conclusive as to the amount of work completed and the amount payable except as specified in Sections 5-1.015, "Records," 6-1.075, "Guarantee," and 9-1.09, "Clerical Errors."

The Contractor's failure to comply with the claim procedures is a bar to arbitration under Pub Cont Code § 10240.2.

### 9-1.09 CLERICAL ERRORS

For 3 years after Contract acceptance, estimates and payments are open to correction and adjustment for clerical errors. Either the Department or the Contractor pays to the other the amount due except for clerical errors resulting in an adjustment less than \$200; in which case, no payment is made.

### 9-1.10 ARBITRATION

Pub Cont Code § 10240 through 10240.13 provides for the resolution of contract claims by arbitration.

Start arbitration by filing a complaint with the Office of Administrative Hearings in Sacramento (1 CA Code Regs § 1350). File the arbitration complaint no later than 90 days after receiving the Department's final written decision on a claim (Pub Cont Code § 10240.1).

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## SECTION 10 DUST CONTROL

**(Issued 02-06-09)**

**Replace Section 10 with:**

**SECTION 10 (BLANK)**

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## SECTION 11 MOBILIZATION

**(Issued 06-05-09)**

**Replace Section 11 with:**

**SECTION 11 (BLANK)**

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## SECTION 12 CONSTRUCTION AREA TRAFFIC CONTROL DEVICES

**(Issued 11-07-08)**

**In Section 12-1.01 in the 2nd paragraph, replace the 1st sentence with:**

Attention is directed to Part 6 of the California MUTCD.

## 12-2.01 FLAGGERS

All flaggers shall wear safety apparel meeting the requirements of ANSI/ISEA 107-2004 for Class 2 or 3 garment and complying with 71 Fed Reg 67792.

In addition to the requirements in Part 6 of the California MUTCD, all devices used by the Contractor in the performance of the work shall conform to the provisions in this Section 12-3.

Used signs with the specified sheeting material will be considered satisfactory if they conform to the requirements for visibility and legibility and the colors conform to the requirements in Part 6 of the California MUTCD.

[illegible]

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1. Stop all work within a 60-foot radius of the discovery
2. Protect the discovery area
3. Notify the Engineer

The Department investigates. Do not move archaeological resources or take them from the job site. Do not resume work within the discovery area until authorized.

If, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of an archaeological find, or investigation or recovery of archeological materials, you will be compensated for resulting losses, and an extension of time will be granted, in the same manner as provided for in Section 8-1.09, "Right of Way Delays."

If ordered, furnish resources to assist in the investigation or recovery of archaeological resources. This work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

#### **14-2.03 ARCHAEOLOGICAL MONITORING AREA**

Section 14-2.03 applies if an AMA is described in the Contract.

The Department assigns an archaeological monitor to monitor job site activities within the AMA. Do not work within the AMA unless the archeological monitor is present.

The Engineer and the Department archaeological monitor conduct an AMA location field review with you at least 5 business days before start of work. The Department marks the exact boundaries of the AMA on the ground.

If temporary fence (Type ESA) or other enclosure for an AMA is described in the Contract, install temporary fence (Type ESA) or other enclosure to define the boundaries of the AMA during the AMA location field review.

At least 5 business days before starting work within an AMA, submit a schedule of days and hours to be worked for the Engineer's approval. If you require changes in the schedule, submit an update for the Engineer's approval at least 5 business days before any changed work day.

If archaeological resources are discovered within an AMA, comply with Section 14-2.02, "Archaeological Resources."

#### **14-2.04 HISTORIC STRUCTURES**

Reserved

### **14-3 COMMUNITY IMPACTS AND ENVIRONMENTAL JUSTICE**

Reserved

### **14-4 NATIVE AMERICAN CONCERNS**

Reserved

### **14-5 AESTHETICS**

Reserved

### **14-6 BIOLOGICAL RESOURCES**

#### **14-6.01 GENERAL**

Reserved

#### **14-6.02 BIRD PROTECTION**

Protect migratory and nongame birds, their occupied nests, and their eggs.

The Department anticipates nesting or attempted nesting from February 15 to September 1.

The federal Migratory Bird Treaty Act, 16 USC § 703–711, and 50 CFR Pt 10 and Fish & Game Code §§ 3503, 3513, and 3800 protect migratory and nongame birds, their occupied nests, and their eggs.

The federal Endangered Species Act of 1973, 16 USC §§ 1531 and 1543, and the California Endangered Species Act, Fish & Game Code §§ 2050–2115.5, prohibit the take of listed species and protect occupied and unoccupied nests of threatened and endangered bird species.

The Bald and Golden Eagle Protection Act, 16 USC § 668, prohibits the destruction of bald and golden eagles and their occupied and unoccupied nests.

If migratory or nongame bird nests are discovered that may be adversely affected by construction activities or an injured or killed bird is found, immediately:

1. Stop all work within a 100-foot radius of the discovery.
2. Notify the Engineer.

The Department investigates. Do not resume work within the specified radius of the discovery until authorized.

When ordered, use exclusion devices, take nesting prevention measures, remove and dispose of partially constructed and unoccupied nests of migratory or nongame birds on a regular basis to prevent their occupation, or perform any combination of these. This work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

Prevent nest materials from falling into waterways.

Bird protection that causes a delay to the controlling activity is a condition unfavorable to the suitable prosecution of work as specified in Section 8-1.05, "Temporary Suspension of Work."

## **14-7 PALEONTOLOGICAL RESOURCES**

If paleontological resources are discovered at the job site, do not disturb the material and immediately:

1. Stop all work within a 60-foot radius of the discovery
2. Protect the area
3. Notify the Engineer

The Department investigates and modifies the dimensions of the protected area if necessary. Do not move paleontological resources or take them from the job site. Do not resume work within the specified radius of the discovery until authorized.

## **14-8 NOISE AND VIBRATION**

### **14-8.01 GENERAL**

Reserved

### **14-8.02 NOISE CONTROL**

Do not exceed 86 dBA LMax at 50 feet from the job site activities from 9 p.m. to 6 a.m.

Equip an internal combustion engine with the manufacturer-recommended muffler. Do not operate an internal combustion engine on the job site without the appropriate muffler.

## **14-9 AIR QUALITY**

### **14-9.01 AIR POLLUTION CONTROL**

Comply with air pollution control rules, regulations, ordinances, and statutes that apply to work performed under the Contract, including air pollution control rules, regulations, ordinances, and statutes provided in Govt Code § 11017 (Pub Cont Code § 10231).

Do not burn material to be disposed of.

### **14-9.02 DUST CONTROL**

Prevent and alleviate dust by applying water, dust palliative, or both under Section 14-9.01.

Apply water under Section 17, "Watering."

Apply dust palliative under Section 18, "Dust Palliative."

If ordered, apply water, dust palliative, or both to control dust caused by public traffic. This work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

## **14-10 SOLID WASTE DISPOSAL AND RECYCLING**

### **14-10.01 SOLID WASTE DISPOSAL AND RECYCLING**

Submit an annual Solid Waste Disposal and Recycling Report between January 1 and 15 for each year work is performed under the Contract at any time during the previous calendar year. Show the types and amounts of project-generated solid waste taken to or diverted from landfills or reused on the project from January 1 through December 31 of the previous calendar year.

Submit a final annual Solid Waste Disposal and Recycling Report within 5 business days after Contract acceptance. Show the types and amounts of project-generated solid waste taken to or diverted from landfills or reused on the project from January 1 to Contract acceptance.

For each failure to submit a completed form, the Department withholds \$10,000.

### 14-11.01 GENERAL

## 14-11.02 ASBESTOS AND HAZARDOUS SUBSTANCES

## 14-12 OTHER INTERAGENCY RELATIONS

### 14-13 PAYMENT

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**(Issued 05-01-09)**

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**(Issued 09-16-11)**

**19-1.02 (BLANK)**

### 19-1.03 GRADE TOLERANCE

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Cementitious material used in soil cement bedding shall conform to the provisions in Section 90-2.01, "Cementitious Materials." Supplementary cementitious material will not be required.

The aggregate, cementitious material, and water shall be proportioned either by weight or by volume. Soil cement bedding shall contain not less than 282 pounds of cementitious material per cubic yard. The water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed.

Unless otherwise shown on the plans or specified in these specifications or the special provisions, material for structure backfill to be compacted to a relative compaction of not less than 90 percent, except material to be placed behind retaining walls, shall consist of material free of rocks, broken concrete, other solid material exceeding 3 inches in greatest dimension, or organic or other unsatisfactory material.

Cementitious material shall conform to the provisions in Section 90-2.01, "Cementitious Materials." Supplementary cementitious material will not be required.

The aggregate, cementitious material, and water shall be proportioned either by weight or by volume. Slurry cement backfill shall contain not less than 188 pounds of cementitious material per cubic yard. The water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed.

[illegible]

**(Issued 04-20-12)**

## 20-2.03 SOIL AMENDMENT

Soil amendment must comply with the Food & Agri Code.

**In Section 20-3.04A delete the last paragraph.**

Oil or pelleted forms of pesticides for weed control shall not be used.

**Replace Section 20-4.055 with:**

**20-4.055 PRUNING**

Prune plants under ANSI A300 (Part 1) published by the Tree Care Industry Association.

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**SECTION 24 LIME STABILIZATION**  
**(Issued 06-05-09)**

**Replace Section 24 with:**  
**SECTION 24 LIME STABILIZED SOIL**

**24-1.01 GENERAL**

**24-1.01A Summary**

Section 24 includes specifications for stabilizing soil by mixing lime and water with soil and compacting the mixture to the specified dimensions.

**24-1.01B Definitions**

**lime:** Quicklime made from high-calcium or dolomitic sources specified under ASTM C 51. For high-calcium quicklime, the calcium oxide content must be greater than 90 percent. For dolomitic quicklime, the calcium oxide content must be greater than 55 percent and the combined calcium oxide and magnesium oxide content must be greater than 90 percent.

**mellowing period:** The time between the initial and final mixing to promote initial chemical reactions between lime, water, and soil.

**24-1.01C Submittals**

From 30 to 180 days before use, submit one 10-pound sample of each lime product proposed and from each source.

Submit lime samples in airtight containers under ASTM C 50. Mark the sample date on the container. Include the MSDS and chemical and physical analysis with the submittal.

With the lime samples, submit a Certificate of Compliance from the pre-qualified lime source under Section 6-1.07, "Certificates of Compliance," with a statement certifying the lime furnished is the same as that pre-qualified.

Fifteen days before starting soil stabilization activities, submit for the Engineer's approval a laboratory to perform quality control tests. The laboratory must be qualified under the Department's Independent Assurance Program.

Before you apply lime in slurry form, submit the slurry's lime content for Engineer's approval 25 days before application.

Before performing quality control sampling and testing, submit the time and location the sampling and testing will occur. Submit quality control testing results within 24 hours of receiving the results.

Submit a weighmaster certificate or bill of lading with each load of lime delivered to the jobsite.

**24-1.01D Quality Control and Assurance**

**General**

Perform quality control testing in the presence of the Engineer.

Place unique, sequentially numbered lock seals on each load and affix them to trailer blow down valves that are locked open. The bill of lading for each lime delivery must have that specific lock seal number legibly and visibly imprinted.

The Engineer samples each lime delivery truck at the job site and randomly tests them off-site.

**Pre-qualification of Lime Sources**

Lime sources must be listed on the Department's pre-qualified products list. The list is available at the METS web site.

The pre-qualified list for lime sources describes the application procedures for inclusion on the list.

### **Preparing Soil**

After you prepare an area for lime soil stabilization, test the soil to be stabilized every 500 cubic yards for relative compaction under California Test 231 and moisture content under California Test 226, and verify the surface grades.

### **Applying Lime**

The Engineer determines the final application rate for each lime product proposed from the samples submitted. If the soil being stabilized changes, the Engineer changes the application rate. Based on California Test 373, the Engineer reports the application rates as the percent of lime by dry weight of soil. The Engineer provides the optimum moisture content determined under California Test 373 for each application rate.

Before applying lime, measure the temperature at the ground surface.

If lime in dry form is used, the Engineer verifies the application rate using the drop pan method once per 40,000 square feet stabilized, or twice per day, whichever is greater.

If lime in slurry form is used, report the quantity of slurry placed by measuring the volume of slurry in the holding tank once per 40,000 square feet stabilized, or twice per day, whichever is greater.

### **Mixing**

For each day of initial mixing, test the moisture content. Sample the material immediately after initial mixing.

Randomly test the adequacy of the final mixing with a phenolphthalein indicator solution.

During mixing operations, measure the ground temperature at full mixing depth.

After mixing and before compacting, determine maximum density under California Test 216 from composite samples of the mixed material and at each distinct change in material. Test the moisture content of the mixed material under California Test 226. Test the gradation for compliance with "Materials."

### **Compaction**

Test relative compaction on a wet weight basis.

After initial compaction, determine in-place density under California Test 231 and moisture content under California Test 226 at the same locations. The testing frequency must be 1 test per 250 cubic yards of lime stabilized soil. Test in 0.50-foot depth intervals.

Before requesting to compact material in layers greater than 0.50 foot, construct a test strip in the production area and demonstrate the test strip passes compaction tests using the proposed thickness. The test strip must contain no more material than 1 day's production. The Engineer tests at not more than 0.50-foot depth intervals regardless of the thickness of your layers.

Construct test pads by scraping away material to the depth ordered by the Engineer. If a compaction test fails corrective action must include the layers of material already placed above the test pad elevation.

### **Finish Grading**

Do not proceed with construction activities for subsequent layers of material until the Engineer verifies the final grades of the lime stabilized soil.

### **Dispute Resolution**

You and the Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result discrepancies. Notify the Engineer within 5 days of receiving a test result if you dispute the test result.

If you or the Engineer dispute each other's test results, submit written quality control test results and copies of paperwork including worksheets used to determine the disputed test results to the Engineer. An Independent Third Party (ITP) performs referee testing. Before the ITP participates in a dispute resolution, the ITP must be accredited under the Department's Independent Assurance Program. The ITP must be independent of the project. By mutual agreement, the ITP is chosen from:

1. A Department laboratory
2. A Department laboratory in a district or region not in the district or region the project is located
3. The Transportation Laboratory
4. A laboratory not currently employed by you or your lime producer

If split quality control or acceptance samples are not available, the ITP uses any available material representing the disputed material for evaluation.

## 24-1.02 MATERIALS

### 24-1.02A Lime

Lime must comply with ASTM C 977 and the following:

| Lime   |                   |   |
|--|-------------------|---|
| Quality Characteristic                         | ASTM              | Specification   |
| Available Calcium and Magnesium Oxide(min., %) | C 25 <sup>a</sup> | High Calcium Quicklime:<br>CaO > 90<br>Dolomitic Quicklime:<br>CaO > 55 and<br>CaO + MgO > 90 |
| Loss on ignition (max., %)                     | C 25              | 7 (total loss)<br>5 (carbon dioxide)<br>2 (free moisture)                                     |
| Slaking rate                                   | C 110             | 30 °C rise in 8 minutes   |

Notes:

<sup>a</sup> You may use ASTM C25 or ASTM C1301 and ASTM C1271.

A 0.5-pound sample of lime dry-sieved in a mechanical sieve shaker for 10 minutes ±30 seconds must comply with:

| Sieve Sizes | Percentage Passing |
|-------------|--------------------|
| 3/8-inch    | 98-100             |

Slurry must:

1. Be free of contaminants
2. Contain at least the minimum dry solids
3. Have uniform consistency

If you prepare lime slurry, prepare it at the jobsite.

### 24-1.02B Water

If available, use potable water. Inform the Engineer if a water source other than potable water is used. If not using potable water, water for mixing soil and lime must:

1. Contain no more than 650 parts per million of chlorides as Cl, and no more than 1,300 parts per million of sulfates as SO<sub>4</sub>
2. Not contain an amount of impurities that will cause a reduction in the strength of the stabilize soil

### 24-1.02C Mixed Material

Take a composite sample from 5 random locations after initial mixing. The moisture content of the composite sample tested under California Test 226 must be a minimum of 3 percent greater than optimum. Determine the moisture versus density relationship of the composite sample material determined under California Test 216, except Part 2, Section E, Paragraph 6 is modified as follows:

After adjustment of the moisture content, compact each of the remaining test specimens in the mold, then record the water adjustment, tamper reading, and the corresponding adjusted wet density from the chart on

Table 1 using the column corresponding to the actual wet weight of the test specimen compacted. Note each of these wet weights on Line I.

The mixed material before compaction excluding rock must comply with:

| Sieve Sizes | Percentage Passing |
|-------------|--------------------|
| 1"          | 98 - 100           |
| No. 4       | 60 - 100           |

#### **24-1.02D Curing Treatment**

Curing treatment may be any of the following:

1. Water cure
2. Curing seal
3. Moist material blanket

Curing seal must be SS or CSS grade asphaltic emulsion under Section 94, "Asphaltic Emulsions."

### **24-1.03 CONSTRUCTION**

#### **24-1.03A General**

If using different types of lime or lime from more than one source, do not mix them. The Engineer determines separate application rates.

Deliver lime in full loads unless it is the last load needed for a work shift.

Apply lime at ground temperatures above 35 °F. Do not apply lime if you expect the ground temperature to drop below 35 °F before you complete mixing and compacting.

During mixing, maintain the in-place moisture of the soil to be stabilized a minimum 3 percent above the optimum moisture determined under California Test 216 as modified in "Mixed Material." During compaction and finish grading, add water to the surface to prevent drying until the next layer of mixed material is placed, or until you apply curing treatment.

Scarify the surface of lime stabilized soil at least 2 inches between each layer. Do not scarify the final surface of the lime stabilized soil.

Between the time of applying lime and 3 days after applying curing treatment, only allow equipment or vehicles on the soil being stabilized that are essential to the work.

#### **24-1.03B Preparing Soil**

Except for soil clods, remove rocks or solids larger than 1/3 of the layer thickness. Regardless of the layer thickness, remove rocks and solids greater than 4 inches. Notify the Engineer if you encounter rocks or solids greater than 1/3 of the layer thickness.

Before adding lime, place the soil to be stabilized to within 0.08 foot of the specified lines and grades and compact to not less than 90 percent relative compaction.

#### **24-1.03C Applying Lime**

Apply lime uniformly over the area to be stabilized using a vane spreader.

The Engineer determines the final application rate. Do not vary from this application rate by more than 5 percent.

Apply lime in dry form. If you request and the Engineer approves, you may apply lime in slurry form.

Lime slurry must be in suspension during application. Apply lime slurry uniformly making successive passes over a measured section or roadway until the specified lime content is reached. Apply the residue from lime slurry over the length of the roadway being processed.

#### **24-1.03D Mixing**

Lime and soil to be stabilized must be mixed uniformly at least twice to within 0.10 foot of the specified depth at any point. If the mixing depth exceeds the specified depth by more than 10 percent, add lime in proportion to the exceeded depth. The Department does not pay for this added lime.

Mix lime on the same day it is applied. After the initial mixing, allow a mellowing period for at least 36 hours before final mixing. Moisture content during the mellowing period determined under California Test 226 must be at

least 3 percent higher than the optimum moisture content. You may add water and mix during the mellowing period.

Remix until the mixture is uniform with no streaks or pockets of lime.

Except for clods larger than 1 inch, mixed material must have a color reaction with sprayed phenolphthalein alcohol indicator solution.

Complete all the mixing work within 7 days of the initial application of lime.

#### **24-1.03E Compaction**

Begin compacting immediately after final mixing, but not less than 36 hours after the beginning of initial mixing.

Compact by using sheepfoot or segmented wheel rollers immediately followed by steel drum or pneumatic-tired rollers. Do not use vibratory rollers.

If you request and the Engineer approves, you may compact mixed material in layers greater than 0.50 foot.

If the specified thickness is 0.50 foot or less, compact in one layer. If the specified thickness is more than 0.50 foot, compact in 2 or more layers of approximately equal thickness. The maximum compacted thickness of any one layer must not exceed 0.50 foot unless you first demonstrate your equipment and methods provide uniform distribution of lime and achieve the specified compaction.

Use other compaction methods in areas inaccessible to rollers.

Compact the lime stabilized soil to at least 95 percent relative compaction determined under California Test 216 as modified under "Mixed Material." The relative compaction is determined on a wet weight basis.

#### **24-1.03F Finish Grading**

Maintain the moisture content of the lime stabilized soil through the entire finish grading operation at a minimum of 3 percent above optimum moisture content.

The finished surface of the lime stabilized soil must not vary more than 0.08 foot above or below the grade established by the Engineer unless the lime stabilized soil is to be covered by material paid for by the cubic yard, in which case the finished surface may not vary above the grade established by the Engineer.

If lime stabilized soil is above the allowable tolerance, trim, remove, and dispose of the excess material. Do not leave loose material on the finished surface. If finish rolling cannot be completed within 2 hours of trimming, defer trimming.

If lime stabilized soil is below the allowable tolerance, you may use trimmed material to fill low areas only if final grading and final compaction occurs within 48 hours of beginning initial compaction. Before placing trimmed material, scarify the surface of the area to be filled at least 2 inches deep.

Finish rolling of trimmed surfaces must be performed with at least 1 complete coverage with steel drum or pneumatic-tired rollers.

#### **24-1.03G Curing**

##### **General**

Choose the method of curing.

Apply the chosen cure method within 48 hours of completing the sheepfoot or segmented wheel compaction.

Apply the chosen cure method within the same day of any trimming and finish grading.

##### **Water Cure**

Water may be used to cure the finished surface before you place a moist material blanket, or apply curing seal. Keep the surface above the optimum moisture content of the lime stabilized soil. Use this method for no more than 3 days, after which you must place a curing seal or moist material blanket.

##### **Curing Seal**

Curing seal equipment must have a gage indicating the volume of curing seal in the storage tank.

If curing seal is used, apply it:

1. To the finished surface of lime stabilized soil under Section 94-1.06, "Applying," of the Standard Specifications
2. At a rate from 0.10 to 0.20 gallon per square yard. The Engineer determines the exact rate
3. When the lime stabilized soil is at optimum moisture
4. When the ambient temperature is above 40 °F and rising

## Moist Material Blanket

#### 24-1.04 MEASUREMENT AND PAYMENT

The contract item prices for the work involved with lime stabilized soil are paid:

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**(Issued 02-16-07)**

- 5.2. Portland cement concrete
- 5.3. Lean concrete base
- 5.4. Cement treated base

**Replace Section 25-1.02B with:**

### 25-1.02B Class 4 Aggregate Subbase

Aggregate must be clean and free from organic matter and other deleterious substances. Aggregate must consist of any combination of:

1. Broken stone
2. Crushed gravel
3. Natural rough surfaced gravel
4. Sand
5. Up to 100 percent of any combination of processed:

- 5.1. Asphalt concrete
- 5.2. Portland cement concrete
- 5.3. Lean concrete base
- 5.4. Cement treated base

AA

## SECTION 26 AGGREGATE BASES

**(Issued 02-16-07)**

**In Section 26-1.02A replace the 1st paragraph with:**

Aggregate must be clean and free from organic matter and other deleterious substances. Aggregate must consist of any combination of:

1. Broken stone
2. Crushed gravel
3. Natural rough surfaced gravel
4. Sand
5. Up to 100 percent of any combination of processed:

- 5.1. Asphalt concrete
- 5.2. Portland cement concrete
- 5.3. Lean concrete base
- 5.4. Cement treated base

**In Section 26-1.02B replace the 1st paragraph with:**

Aggregate must be clean and free from organic matter and other deleterious substances. Aggregate must consist of any combination of:

1. Broken stone
2. Crushed gravel
3. Natural rough surfaced gravel
4. Sand
5. Up to 100 percent of any combination of processed:

- 5.1. Asphalt concrete
- 5.2. Portland cement concrete
- 5.3. Lean concrete base



5.4. Cement treated base

^^

**SECTION 27 CEMENT TREATED BASES**  
**(Issued 07-31-07)**

**In Section 27-1.02 replace the 1st paragraph with:**

Cement shall be Type II portland cement conforming to the provisions in Section 90-2.01A, "Cement."

**In Section 27-1.02 replace the 3rd paragraph with:**

Aggregate for use in Class A cement treated base shall be of such quality that when mixed with cement in an amount not to exceed 5 percent by weight of the dry aggregate and compacted at optimum moisture content, the compressive strength of a sample of the compacted mixture shall not be less than 750 pounds per square inch at 7 days, when tested by California Test 312.

**In Section 27-1.02 replace the 4th paragraph with:**

Aggregate for use in Class B cement treated base shall have a Resistance (R-value) of not less than 60 before mixing with cement and a Resistance (R-value) of not less than 80 after mixing with cement in an amount not to exceed 2.5 percent by weight of the dry aggregate.

**In Section 27-1.07 replace the 9th paragraph with:**

When surfacing material is hot mix asphalt, the low areas shall be filled with hot mix asphalt conforming to the requirements for the lowest layer of hot mix asphalt to be placed as surfacing. This filling shall be done as a separate operation prior to placing the lowest layer of surfacing, and full compensation for this filling will be considered as included in the contract price paid for cement treated base and no additional compensation will be allowed therefor.

^^

**SECTION 28 LEAN CONCRETE BASE**  
**(Issued 05-15-09)**

**In Section 28-1.02 replace the 1st paragraph with:**

Cement shall be Type II portland cement conforming to the provisions in Section 90-2.01A, "Cement."

**In Section 28-1.02 replace the 6th paragraph with:**

Aggregate shall be of such quality that, when mixed with cement in an amount not to exceed 300 pounds per cubic yard, and tested in conformance with the requirements in California Test 548, the compressive strength of a sample will be not less than 700 pounds per square inch at 7 days.

**Replace Section 28-1.05 with:**

Placing of lean concrete base shall conform to the provisions for placing concrete pavement in Section 40-3.04, "Placing Concrete," except that the third paragraph in Section 40-3.04A, "General," shall not apply.

Unless otherwise required by the plans or the special provisions, lean concrete base shall be constructed in not less than 12-foot widths separated by construction joints. Lean concrete base constructed monolithically in widths greater than 26 feet shall be constructed with a longitudinal contraction joint offset not more than 3 feet from the centerline of the width being constructed.

Longitudinal contraction joints in lean concrete base shall be constructed in conformance with the provisions in Section 40-3.08E, "Sawing Method."

Lean concrete base shall not be mixed nor placed while the atmospheric temperature is below 35 °F, and shall not be placed on frozen ground.

Lean concrete base shall be spread, compacted, and shaped in conformance with the provisions in Section 40-3.04D, "Stationary Side Form Construction," and Section 40-3.04E, "Slip-Form Construction."

**In Section 28-1.08 replace the 2nd paragraph with:**

1. When pavement material is hot mix asphalt, the low areas shall be filled with hot mix asphalt conforming to the requirements for the lowest layer of hot mix asphalt to be placed as pavement. This shall be done as a separate operation prior to placing the lowest layer of pavement, and full compensation for this filling will be considered as included in the contract price paid per cubic yard for lean concrete base and no additional compensation will be allowed therefor.
2. When pavement material is portland cement concrete, the low areas shall be filled with pavement concrete at the time and in the same operation that the pavement is placed. Full compensation for this filling will be considered as included in the contract price paid per cubic yard for lean concrete base and no additional compensation will be allowed therefor.

## SECTION 29 TREATED PERMEABLE BASES

(Issued 05-15-09)

Cement shall be Type II portland cement conforming to the provisions in Section 90-2.01A, "Cement."

1. The aggregate need not be separated into sizes.
2. The temperature of the aggregate before adding the asphalt binder shall be not less than 275° F nor more than 325° F.
3. Asphalt treated permeable base stored in excess of 2 hours shall not be used in the work.
4. The aggregate shall be combined with 2.5 percent paving asphalt by weight of the dry aggregate. After testing samples of the Contractor's proposed aggregate supply, the Engineer may order an increase or decrease in the asphalt content. If an increase or decrease is ordered, and the increase or decrease exceeds the specified amount by more than 0.1 percent by weight of the dry aggregate, the compensation payable to the Contractor for the asphalt treated permeable base will be increased or decreased on the basis of the total increase or decrease in asphalt.



The first W8-7 sign in each direction shall be placed where traffic first encounters loose screenings, regardless of which lane the screenings are being spread on. The W13-1 (35) signs need not be placed in those areas with posted speed limits of less than 40 MPH. The signs shall be placed at maximum 2,000-foot intervals along each side of the traveled way and at public roads or streets entering the seal coat area as directed by the Engineer.

On multilane roadways (freeways, expressways and multilane conventional highways) where screenings are being spread on a traffic lane, W8-7 "LOOSE GRAVEL" signs and W13-1 (35) speed advisory signs shall be furnished and placed adjacent to the outside edge of the traveled way nearest to the lane being worked on. The first W8-7 sign shall be placed where the screenings begin with respect to the direction of travel on that lane. The W13-1 (35) signs need not be placed in those areas with posted speed limits of less than 40 MPH. The signs shall be placed at maximum 2,000-foot intervals along the edge of traveled way and at on-ramps, public roads or streets entering the seal coat area as directed by the Engineer.

The W8-7 and W13-1 signs shall be maintained in place at each location until final brooming of the seal coat surface at that location is completed. The W8-7 and W13-1 signs shall conform to the provisions for construction area signs in Section 12, "Construction Area Traffic Control Devices." The signs may be set on temporary portable supports with the W13-1 below the W8-7 or on barricades with the W13-1 sign alternating with the W8-7 sign.

**In Section 37-1.07 replace the 2nd paragraph with:**

Rollers shall be oscillating type pneumatic-tired rollers. A minimum of 2 pneumatic-tired rollers conforming to the provisions in Section 39-3.03 "Spreading and Compacting Equipment," shall be furnished.

**In Section 37-1.09 replace the 2nd paragraph with:**

The above prices and payments shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in applying seal coat, complete in place, including furnishing, placing, maintaining, and removing W8-7 and W13-1 signs, when required, and temporary supports or barricades for the signs, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

**In Section 37-2.05 replace the 6th paragraph with:**

In addition to conforming to the provisions in Section 5-1.10, "Equipment," the identifying number of mixer-spreader trucks shall be at least 2 inches in height, located on the front and rear of the vehicle.

^^

**SECTION 39 ASPHALT CONCRETE  
(Issued 10-19-12)**

**Replace Section 39 with:  
SECTION 39 HOT MIX ASPHALT**

**39-1 GENERAL**

**39-1.01 DESCRIPTION**

Section 39 includes specifications for producing and placing hot mix asphalt (HMA) by mixing aggregate and asphalt binder at a mixing plant and spreading and compacting the HMA mixture.

The special provisions specify one or more types of HMA, including:

1. Type A
2. Type B
3. Open graded friction course (OGFC). OGFC includes hot mix asphalt (open graded)[HMA-O], rubberized hot mix asphalt (open graded) [RHMA-O] and rubberized hot mix asphalt (open graded high binder) [RHMA-O-HB]

4. Rubberized hot mix asphalt (gap graded) [RHMA-G]

The special provisions specify the HMA construction process, including:

1. Standard
2. Method
3. Quality Control / Quality Assurance (QC / QA)

### **39-1.02 MATERIALS**

#### **39-1.02A Geosynthetic Pavement Interlayer**

Geosynthetic pavement interlayer must comply with the specifications in Section 88-1.07, "Pavement Interlayer," for the type of interlayer shown on the plans.

#### **39-1.02B Tack Coat**

Tack coat must comply with the specifications for asphaltic emulsion in Section 94, "Asphaltic Emulsion," or asphalt binder in Section 92, "Asphalts." Choose the type and grade.

Notify the Engineer if you dilute asphaltic emulsion with water. The weight ratio of added water to asphaltic emulsion must not exceed 1 to 1.

Measure added water either by weight or volume in compliance with the specifications for weighing, measuring, and metering devices under Section 9-1.01, "Measurement of Quantities," or you may use water meters from water districts, cities, or counties. If you measure water by volume, apply a conversion factor to determine the correct weight.

With each dilution, submit in writing:

1. The weight ratio of water to bituminous material in the original asphaltic emulsion
2. The weight of asphaltic emulsion before diluting
3. The weight of added water
4. The final dilution weight ratio of water to asphaltic emulsion

#### **39-1.02C Asphalt Binder**

Asphalt binder in HMA must comply with Section 92, "Asphalts," or Section 39-1.02D, "Asphalt Rubber Binder." The special provisions specify the grade.

Asphalt binder for geosynthetic pavement interlayer must comply with Section 92, "Asphalts." Choose from Grades PG 64-10, PG 64-16, or PG 70-10.

#### **39-1.02D Asphalt Rubber Binder**

##### **General**

Use asphalt rubber binder in RHMA-G, RHMA-O, and RHMA-O-HB. Asphalt rubber binder must be a combination of:

1. Asphalt binder
2. Asphalt modifier
3. Crumb rubber modifier (CRM)

The combined asphalt binder and asphalt modifier must be  $80.0 \pm 2.0$  percent by weight of the asphalt rubber binder.

##### **Asphalt Modifier**

Asphalt modifier must be a resinous, high flash point, and aromatic hydrocarbon, and comply with:

### Asphalt Modifier for Asphalt Rubber Binder

| Quality Characteristic                                       | ASTM   | Specification      |
|--|--------|--------------------|
| Viscosity, m <sup>2</sup> /s (x 10 <sup>-6</sup> ) at 100 °C | D 445  | X ± 3 <sup>a</sup> |
| Flash Point, CL.O.C., °C                                     | D 92   | 207 minimum        |
| Molecular Analysis   |        |                    |
| Asphaltenes, percent by mass                                 | D 2007 | 0.1 maximum        |
| Aromatics, percent by mass                                   | D 2007 | 55 minimum         |

Note:

<sup>a</sup> The symbol "X" is the proposed asphalt modifier viscosity. "X" must be between 19 and 36. A change in "X" requires a new asphalt rubber binder design.

Asphalt modifier must be from 2.0 percent to 6.0 percent by weight of the asphalt binder in the asphalt rubber binder.

### Crumb Rubber Modifier

CRM consists of a ground or granulated combination of scrap tire CRM and high natural CRM. CRM must be 75.0 ± 2.0 percent scrap tire CRM and 25.0 ± 2.0 percent high natural CRM by total weight of CRM. Scrap tire CRM must be from any combination of automobile tires, truck tires, or tire buffings.

Sample and test scrap tire CRM and high natural CRM separately. CRM must comply with:

### Crumb Rubber Modifier for Asphalt Rubber Binder

| Quality Characteristic                                      | Test Method | Specification |
|---|-------------|---------------|
| Scrap tire CRM gradation<br>(% passing No. 8 sieve)         | LP-10       | 100           |
| High natural CRM gradation<br>(% passing No. 10 sieve)      | LP-10       | 100           |
| Wire in CRM (% max.)  | LP-10       | 0.01          |
| Fabric in CRM (% max.)                                      | LP-10       | 0.05          |
| CRM particle length (inch max.) <sup>a</sup>                | --          | 3/16          |
| CRM specific gravity <sup>a</sup>                           | CT 208      | 1.1 – 1.2     |
| Natural rubber content in high natural CRM (%) <sup>a</sup> | ASTM D 297  | 40.0 – 48.0   |

Note:

<sup>a</sup> Test at mix design and for Certificate of Compliance.

Only use CRM ground and granulated at ambient temperature. If steel and fiber are cryogenically separated, it must occur before grinding and granulating. Only use cryogenically produced CRM particles that can be ground or granulated and not pass through the grinder or granulator.

CRM must be dry, free-flowing particles that do not stick together. CRM must not cause foaming when combined with the asphalt binder and asphalt modifier. You may add calcium carbonate or talc up to 3 percent by weight of CRM.

### Asphalt Rubber Binder Design and Profile

Submit in writing an asphalt rubber binder design and profile that complies with the asphalt rubber binder specifications. In the design, designate the asphalt, asphalt modifier, and CRM and their proportions. The profile is not a performance specification and only serves to indicate expected trends in asphalt rubber binder properties during binder production. The profile must include the same component sources for the asphalt rubber binder used.

Design the asphalt rubber binder from testing you perform for each quality characteristic and for the reaction temperatures expected during production. The 24-hour (1,440-minute) interaction period determines the design profile. At a minimum, mix asphalt rubber binder components, take samples, and perform and record the following tests:

### Asphalt Rubber Binder Reaction Design Profile

| Test  | Minutes of Reaction <sup>a</sup> |    |    |     |     |     |      | Limits        |
|---|----------------------------------|----|----|-----|-----|-----|------|---------------|
|   | 45                               | 60 | 90 | 120 | 240 | 360 | 1440 |               |
| Cone penetration @ 77 °F, 0.10-mm (ASTM D 217)    | X <sup>b</sup>                   |    |    |     | X   |     | X    | 25 - 70       |
| Resilience @ 77 °F, percent rebound (ASTM D 5329) | X                                |    |    |     | X   |     | X    | 18 min.       |
| Field softening point, °F (ASTM D 36)             | X                                |    |    |     | X   |     | X    | 125 - 165     |
| Viscosity, centipoises (LP-11)                    | X                                | X  | X  | X   | X   | X   | X    | 1,500 - 4,000 |

Notes:

<sup>a</sup> Six hours (360 minutes) after CRM addition, reduce the oven temperature to 275 °F for a period of 16 hours. After the 16-hour (1320 minutes) cool-down after CRM addition, reheat the binder to the reaction temperature expected during production for sampling and testing at 24 hours (1440 minutes).

<sup>b</sup> "X" denotes required testing

### Asphalt Rubber Binder

After interacting for a minimum of 45 minutes, asphalt rubber binder must comply with:

### Asphalt Rubber Binder

| Quality Characteristic              | Test for Quality Control or Acceptance | Test Method | Specification |         |
|-------------------------------------|--|-------------|---------------|---------|
|                                     |  |             | Minimum       | Maximum |
| Cone penetration @ 77 °F, 0.10-mm   | Acceptance                             | ASTM D 217  | 25            | 70      |
| Resilience @ 77 °F, percent rebound | Acceptance                             | ASTM D 5329 | 18            | --      |
| Field softening point, °F           | Acceptance                             | ASTM D 36   | 125           | 165     |
| Viscosity @ 375 °F, centipoises     | Quality Control                        | LP-11       | 1,500         | 4,000   |

### 39-1.02E Aggregate

Aggregate must be clean and free from deleterious substances. Aggregate:

1. Retained on the No. 4 sieve is coarse
2. Passing the No. 4 sieve is fine
3. Added and passing the No. 30 sieve is supplemental fine, including:
  - 3.1. Hydrated lime
  - 3.2. Portland cement
  - 3.3. Fines from dust collectors

The special provisions specify the aggregate gradation for each HMA type.

The specified aggregate gradation is before the addition of asphalt binder and includes supplemental fines. The Engineer tests for aggregate grading under California Test 202, modified by California Test 105 if there is a difference in specific gravity of 0.2 or more between the coarse and fine parts of different aggregate blends.

Choose a sieve size target value (TV) within each target value limit presented in the aggregate gradation tables.

**Aggregate Gradation  
(Percentage Passing)  
HMA Types A and B**

3/4-inch HMA Types A and B

| Sieve Sizes | Target Value Limits | Allowable Tolerance |
|-------------|---------------------|---------------------|
| 1"          | 100                 | —                   |
| 3/4"        | 90 - 100            | TV $\pm$ 5          |
| 1/2"        | 70 - 90             | TV $\pm$ 6          |
| No. 4       | 45 - 55             | TV $\pm$ 7          |
| No. 8       | 32 - 40             | TV $\pm$ 5          |
| No. 30      | 12 - 21             | TV $\pm$ 4          |
| No. 200     | 2 - 7               | TV $\pm$ 2          |

1/2-inch HMA Types A and B

| Sieve Sizes | Target Value Limits | Allowable Tolerance |
|-------------|---------------------|---------------------|
| 3/4"        | 100                 | —                   |
| 1/2"        | 95 - 99             | TV $\pm$ 6          |
| 3/8"        | 75 - 95             | TV $\pm$ 6          |
| No. 4       | 55 - 66             | TV $\pm$ 7          |
| No. 8       | 38 - 49             | TV $\pm$ 5          |
| No. 30      | 15 - 27             | TV $\pm$ 4          |
| No. 200     | 2 - 8               | TV $\pm$ 2          |

3/8-inch HMA Types A and B

| Sieve Sizes | Target Value Limits | Allowable Tolerance |
|-------------|---------------------|---------------------|
| 1/2"        | 100                 | —                   |
| 3/8"        | 95 - 100            | TV $\pm$ 6          |
| No. 4       | 58 - 72             | TV $\pm$ 7          |
| No. 8       | 34 - 48             | TV $\pm$ 6          |
| No. 30      | 18 - 32             | TV $\pm$ 5          |
| No. 200     | 2 - 9               | TV $\pm$ 2          |

No. 4 HMA Types A and B

| Sieve Sizes | Target Value Limits | Allowable Tolerance |
|-------------|---------------------|---------------------|
| 3/8"        | 100                 | —                   |
| No. 4       | 95 - 100            | TV $\pm$ 7          |
| No. 8       | 72 - 77             | TV $\pm$ 7          |
| No. 30      | 37 - 43             | TV $\pm$ 7          |
| No. 200     | 2 - 12              | TV $\pm$ 4          |



### Rubberized Hot Mix Asphalt - Gap Graded (RHMA-G)

| 3/4-inch RHMA-G |                     |                     |
|-----------------|---------------------|---------------------|
| Sieve Sizes     | Target Value Limits | Allowable Tolerance |
| 1"              | 100                 | —                   |
| 3/4"            | 95 - 100            | TV ±5               |
| 1/2"            | 83 - 87             | TV ±6               |
| 3/8"            | 65 - 70             | TV ±6               |
| No. 4           | 28 - 42             | TV ±7               |
| No. 8           | 14 - 22             | TV ±5               |
| No. 200         | 0 - 6               | TV ±2               |

| 1/2-inch RHMA-G |                     |                     |
|-----------------|---------------------|---------------------|
| Sieve Sizes     | Target Value Limits | Allowable Tolerance |
| 3/4"            | 100                 | —                   |
| 1/2"            | 90 - 100            | TV ±6               |
| 3/8"            | 83 - 87             | TV ±6               |
| No. 4           | 28 - 42             | TV ±7               |
| No. 8           | 14 - 22             | TV ±5               |
| No. 200         | 0 - 6               | TV ±2               |

### Open Graded Friction Course (OGFC)

| 1-inch OGFC |                     |                     |
|-------------|---------------------|---------------------|
| Sieve Sizes | Target Value Limits | Allowable Tolerance |
| 1 1/2"      | 100                 | —                   |
| 1"          | 99 - 100            | TV ±5               |
| 3/4"        | 85 - 96             | TV ±5               |
| 1/2"        | 55 - 71             | TV ±6               |
| No. 4       | 10 - 25             | TV ±7               |
| No. 8       | 6 - 16              | TV ±5               |
| No. 200     | 1 - 6               | TV ±2               |

| 1/2-inch OGFC |                     |                     |
|---------------|---------------------|---------------------|
| Sieve Sizes   | Target Value Limits | Allowable Tolerance |
| 3/4"          | 100                 | —                   |
| 1/2"          | 95 - 100            | TV ±6               |
| 3/8"          | 78 - 89             | TV ±6               |
| No. 4         | 28 - 37             | TV ±7               |
| No. 8         | 7 - 18              | TV ±5               |
| No. 30        | 0 - 10              | TV ±4               |
| No. 200       | 0 - 3               | TV ±2               |

| 3/8-inch OGFC |                     |                     |
|---------------|---------------------|---------------------|
| Sieve Sizes   | Target Value Limits | Allowable Tolerance |
| 1/2"          | 100                 | —                   |
| 3/8"          | 90 - 100            | TV ±6               |
| No. 4         | 29 - 36             | TV ±7               |
| No. 8         | 7 - 18              | TV ±6               |
| No. 30        | 0 - 10              | TV ±5               |
| No. 200       | 0 - 3               | TV ±2               |

Before the addition of asphalt binder and lime treatment, aggregate must comply with:

| Aggregate Quality                                     |             |          |    |        |      |
|---|-------------|----------|----|--------|------|
| Quality Characteristic                                | Test Method | HMA Type |    |        |      |
|   |             | A        | B  | RHMA-G | OGFC |
| Percent of crushed particles                          | CT 205      |          |    |        |      |
| Coarse aggregate (% min.)                             |             |          |    |        |      |
| One fractured face                                    |             | 90       | 25 | --     | 90   |
| Two fractured faces                                   |             | 75       | -- | 90     | 75   |
| Fine aggregate (% min.)                               | CT 205      |          |    |        |      |
| (Passing No. 4 sieve and retained on No. 8 sieve.)    |             |          |    |        |      |
| One fractured face                                    |             | 70       | 20 | 70     | 90   |
| Los Angeles Rattler (% max.)                          | CT 211      |          |    |        |      |
| Loss at 100 Rev.                                      |             | 12       | -- | 12     | 12   |
| Loss at 500 Rev.                                      |             | 45       | 50 | 40     | 40   |
| Sand equivalent (min.) <sup>a</sup>                   | CT 217      | 47       | 42 | 47     | --   |
| Fine aggregate angularity (% min.) <sup>b</sup>       | CT 234      | 45       | 45 | 45     | --   |
| Flat and elongated particles (% max. by weight @ 5:1) | CT 235      | 10       | 10 | 10     | 10   |

Notes:

<sup>a</sup> Reported value must be the average of 3 tests from a single sample.

<sup>b</sup> The Engineer waives this specification if HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

### 39-1.02F Reclaimed Asphalt Pavement

You may produce HMA using reclaimed asphalt pavement (RAP). HMA produced using RAP must comply with the specifications for HMA except aggregate quality specifications do not apply to RAP. You may substitute RAP aggregate for a part of the virgin aggregate in HMA in a quantity not exceeding 15.0 percent of the aggregate blend. Do not use RAP in OGFC and RHMA-G.

Assign the substitution rate of RAP aggregate for virgin aggregate with the job mix formula (JMF) submittal. The JMF must include the percent of RAP used. If you change your assigned RAP aggregate substitution rate by more than 5 percent (within the 15.0 percent limit), submit a new JMF.

Process RAP from asphalt concrete. You may process and stockpile RAP throughout the project's life. Prevent material contamination and segregation. Store RAP in stockpiles on smooth surfaces free of debris and organic material. Processed RAP stockpiles must consist only of homogeneous RAP.

### 39-1.03 HOT MIX ASPHALT MIX DESIGN REQUIREMENTS

#### 39-1.03A General

A mix design consists of performing California Test 367 and laboratory procedures on combinations of aggregate gradations and asphalt binder contents to determine the optimum binder content (OBC) and HMA mixture qualities. If RAP is used, use Laboratory Procedure LP-9. The result of the mix design becomes the proposed JMF.

Use Form CEM-3512 to document aggregate quality and mix design data. Use Form CEM-3511 to present the JMF.

Laboratories testing aggregate qualities and preparing the mix design and JMF must be qualified under the Department's Independent Assurance Program. Take samples under California Test 125.

The Engineer reviews the aggregate qualities, mix design, and JMF and verifies and accepts the JMF.

You may change the JMF during production. Do not use the changed JMF until the Engineer accepts it. Except when adjusting the JMF in compliance with Section 39-1.03E, "Job Mix Formula Verification," perform a new mix design and submit in writing a new JMF submittal for changing any of the following:

1. Target asphalt binder percentage
2. Asphalt binder supplier
3. Asphalt rubber binder supplier
4. Component materials used in asphalt rubber binder or percentage of any component materials
5. Combined aggregate gradation
6. Aggregate sources
7. Substitution rate for RAP aggregate of more than 5 percent
8. Any material in the JMF

For OGFC, submit in writing a complete JMF submittal except asphalt binder content. The Engineer determines the asphalt binder content under California Test 368 within 20 days of your complete JMF submittal and provides you a Form CEM-3513.

### 39-1.03B Hot Mix Asphalt Mix Design

Perform a mix design that produces HMA in compliance with:

#### Hot Mix Asphalt Mix Design Requirements

| Quality Characteristic                 | Test Method         | HMA Type    |             |                          |
|--|---------------------|-------------|-------------|--------------------------|
|  |                     | A           | B           | RHMA-G                   |
| Air voids content (%)                  | CT 367 <sup>a</sup> | 4.0         | 4.0         | Special Provisions       |
| Voids in mineral aggregate (% min.)    | LP-2                |             |             |                          |
| No. 4 grading                          |                     | 17.0        | 17.0        | --                       |
| 3/8" grading                           |                     | 15.0        | 15.0        | --                       |
| 1/2" grading                           |                     | 14.0        | 14.0        | 18.0 – 23.0 <sup>b</sup> |
| 3/4" grading                           |                     | 13.0        | 13.0        | 18.0 – 23.0 <sup>b</sup> |
| Voids filled with asphalt (%)          | LP-3                |             |             |                          |
| No. 4 grading                          |                     | 76.0 – 80.0 | 76.0 – 80.0 | Note d                   |
| 3/8" grading                           |                     | 73.0 – 76.0 | 73.0 – 76.0 |                          |
| 1/2" grading                           |                     | 65.0 – 75.0 | 65.0 – 75.0 |                          |
| 3/4" grading                           |                     | 65.0 – 75.0 | 65.0 – 75.0 |                          |
| Dust proportion                        | LP-4                |             |             |                          |
| No. 4 and 3/8" gradings                |                     | 0.9 – 2.0   | 0.9 – 2.0   | Note d                   |
| 1/2" and 3/4" gradings                 |                     | 0.6 – 1.3   | 0.6 – 1.3   |                          |
| Stabilometer value (min.) <sup>c</sup> | CT 366              |             |             |                          |
| No. 4 and 3/8" gradings                |                     | 30          | 30          | --                       |
| 1/2" and 3/4" gradings                 |                     | 37          | 35          | 23                       |

Notes:

<sup>a</sup> Calculate the air voids content of each specimen using California Test 309 and Lab Procedure LP-1. Modify California Test 367, Paragraph C5, to use the exact air voids content specified in the selection of OBC.

<sup>b</sup> Voids in mineral aggregate for RHMA-G must be within this range.

<sup>c</sup> Modify California Test 304, Part 2.B.2.c: "After compaction in the compactor, cool to 140 °± 5 °F by allowing the briquettes to cool at room temperature for 0.5-hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."

<sup>d</sup> Report this value in the JMF submittal.

For stability and air voids content, prepare 3 briquettes at the OBC and test for compliance. Report the average of 3 tests. Prepare new briquettes and test if the range of stability for the 3 briquettes is more than 8 points. The average air void content may vary from the specified air void content by ±0.5 percent.

You may use the briquettes used for stability testing to determine bulk specific gravity under CT 308. If you use the same briquettes and tests using bulk specific gravity fail, you may prepare 3 new briquettes and determine a new bulk specific gravity.

### 39-1.03C Job Mix Formula Submittal

Each JMF submittal must consist of:

1. Proposed JMF on Form CEM-3511
2. Mix design documentation on Form CEM-3512 dated within 12 months of submittal
3. JMF verification on Form CEM-3513, if applicable
4. JMF renewal on Form CEM-3514, if applicable
5. Materials Safety Data Sheets (MSDS) for:
  - 5.1. Asphalt binder
  - 5.2. Base asphalt binder used in asphalt rubber binder
  - 5.3. CRM and asphalt modifier used in asphalt rubber binder
  - 5.4. Blended asphalt rubber binder mixture

- 5.5. Supplemental fine aggregate except fines from dust collectors
- 5.6. Antistrip additives

If the Engineer requests in writing, sample the following materials in the presence of the Engineer and place in labeled containers weighing no more than 50 pounds each:

- 1. Coarse, fine, and supplemental fine aggregate from stockpiles, cold feed belts, or hot bins. Samples must include at least 120 pounds for each coarse aggregate, 80 pounds for each fine aggregate, and 10 pounds for each type of supplemental fines. The Department combines these aggregate samples to comply with the JMF target values submitted on Form CEM-3511.
- 2. RAP from stockpiles or RAP system. Samples must be at least 60 pounds.
- 3. Asphalt binder from the binder supplier. Samples must be in two 1-quart cylindrical shaped cans with open top and friction lids.
- 4. Asphalt rubber binder with the components blended in the proportions to be used. Samples must be in four 1-quart cylindrical shaped cans with open top and friction lids.

Notify the Engineer in writing at least 2 business days before sampling materials. For aggregate and RAP, split the samples into at least 4 parts. Submit 3 parts to the Engineer and use 1 part for your testing.

### **39-1.03D Job Mix Formula Review**

The Engineer reviews each mix design and proposed JMF within 5 business days from the complete JMF submittal. The review consists of reviewing the mix design procedures and comparing the proposed JMF with the specifications.

The Engineer may verify aggregate qualities during this review period.

### **39-1.03E Job Mix Formula Verification**

If you cannot submit a Department-verified JMF on Form CEM-3513 dated within 12 months before HMA production, the Engineer verifies the JMF.

Based on your testing and production experience, you may submit on Form CEM-3511 an adjusted JMF before the Engineer's verification testing. JMF adjustments may include a change in the:

- 1. Asphalt binder content target value up to  $\pm 0.6$  percent from the optimum binder content value submitted on Form CEM-3512 except do not adjust the target value for asphalt rubber binder for RHMA-G below 7.0 percent
- 2. Aggregate gradation target values within the target value limits specified in the aggregate gradation tables

For HMA Type A, Type B, and RHMA-G, the Engineer verifies the JMF from samples taken from HMA produced by the plant to be used. Notify the Engineer in writing at least 2 business days before sampling materials.

In the Engineer's presence and from the same production run, take samples of:

- 1. Aggregate
- 2. Asphalt binder
- 3. RAP
- 4. HMA

Sample aggregate from cold feed belts or hot bins. Sample RAP from the RAP system. Sample HMA under California Test 125 except if you request in writing and the Engineer approves, you may sample from any of the following locations:

- 1. The plant
- 2. A truck
- 3. A windrow
- 4. The paver hopper
- 5. The mat behind the paver

You may sample from a different project including a non-Department project if you make arrangements for the Engineer to be present during sampling.

For aggregate, RAP, and HMA, split the samples into at least 4 parts and label their containers. Submit 3 split parts to the Engineer and use 1 part for your testing.

The Engineer verifies each proposed JMF within 20 days of receiving all verification samples and the JMF submittal has been accepted. If you request in writing, the Engineer verifies RHMA-G quality requirements within 3 business days of sampling. Verification is testing for compliance with the specifications for:

1. Aggregate quality
2. Aggregate gradation (JMF TV  $\pm$  tolerance)
3. Asphalt binder content (JMF TV  $\pm$  tolerance)
4. HMA quality specified in the table Hot Mix Asphalt Mix Design Requirements except:
  - 4.1. Air voids content (design value  $\pm$  2.0 percent)
  - 4.2. Voids filled with asphalt (report only if an adjustment for asphalt binder content target value is less than or equal to  $\pm$  0.3 percent from OBC)
  - 4.3. Dust proportion (report only if an adjustment for asphalt binder content target value is less than or equal to  $\pm$  0.3 percent from OBC)

The Engineer prepares 3 briquettes from a single split sample. To verify the JMF for stability and air voids content, the Engineer tests the 3 briquettes and reports the average of 3 tests. The Engineer prepares new briquettes if the range of stability for the 3 briquettes is more than 8 points.

The Engineer may use the briquettes used for stability testing to determine bulk specific gravity under CT 308. If the Engineer uses the same briquettes and the tests using bulk specific gravity fail, the Engineer prepares 3 new briquettes and determines a new bulk specific gravity.

If the Engineer verifies the JMF, the Engineer provides you a Form CEM-3513.

If the Engineer's tests on plant-produced samples do not verify the JMF, the Engineer notifies you in writing and you must submit a new JMF submittal or submit an adjusted JMF based on your testing. JMF adjustments may include a change in the:

1. Asphalt binder content target value up to  $\pm$ 0.6 percent from the optimum binder content value submitted on Form CEM-3512 except do not adjust the target value for asphalt rubber binder for RHMA-G below 7.0 percent
2. Aggregate gradation target values within the target value limits specified in the aggregate gradation tables

You may adjust the JMF only once due to a failed verification test. An adjusted JMF requires a new Form CEM-3511 and verification of a plant-produced sample.

A verified JMF is valid for 12 months.

For each HMA type and aggregate size specified, the Engineer verifies at the State's expense up to 2 proposed JMF including a JMF adjusted after verification failure. The Engineer deducts \$3,000 from payments for each verification exceeding this limit. This deduction does not apply to verifications initiated by the Engineer or JMF renewal.

### **39-1.03F Job Mix Formula Renewal**

You may request a JMF renewal by submitting the following:

1. Proposed JMF on Form CEM-3511
2. A previously verified JMF documented on Form CEM-3513 dated within 12 months
3. Mix design documentation on Form CEM-3512 used for the previously verified JMF

If the Engineer requests in writing, sample the following materials in the presence of the Engineer and place in labeled containers weighing no more than 50 pounds each:

1. Coarse, fine, and supplemental fine aggregate from stockpiles, cold feed belts, or hot bins. Samples must include at least 120 pounds for each coarse aggregate, 80 pounds for each fine aggregate, and 10 pounds for each type of supplemental fines. The Department combines these aggregate samples to comply with the JMF target values submitted on Form CEM-3511.
2. RAP from stockpiles or RAP system. Samples must be at least 60 pounds.
3. Asphalt binder from the binder supplier. Samples must be in two 1-quart cylindrical shaped cans with open top and friction lids.

4. Asphalt rubber binder with the components blended in the proportions to be used. Samples must be in four 1-quart cylindrical shaped cans with open top and friction lids.

Notify the Engineer in writing at least 2 business days before sampling materials. For aggregate and RAP, split samples into at least 4 parts. Submit 3 parts to the Engineer and use 1 part for your testing.

The Engineer may verify aggregate qualities during this review period.

Notify the Engineer in writing at least 2 business days before sampling materials. For aggregate, RAP, and HMA, split the samples into at least 4 parts. Submit 3 parts to the Engineer and use 1 part for your testing.

The Engineer verifies the JMF renewal submittal under Section 39-1.03E, "Job Mix Formula Verification," except:

1. The Engineer retains samples until you provide test results for your part on Form CEM-3514.
2. The Engineer tests samples of materials obtained from the HMA production unit after you submit test results that comply with the specifications for the quality characteristics under Section 39-1.03E, "Job Mix Formula Verification."
3. The Engineer verifies each proposed JMF renewal within 20 days of receiving verification samples.
4. You may not adjust the JMF due to a failed verification.
5. For each HMA type and aggregate gradation specified, the Engineer verifies at the State's expense 1 proposed JMF renewal within a 12-month period.

The most recent aggregate quality test results within the past 12 months may be used for verification of JMF renewal or the Engineer may perform aggregate quality tests for verification of JMF renewal.

If the Engineer verifies the JMF renewal, the Engineer provides you a Form CEM-3513.

### **39-1.03G Job Mix Formula Modification**

For an accepted JMF, you may change binder source one time during production.

Submit your modified JMF request a minimum of 3 business days before production. Each modified JMF submittal must consist of:

1. Proposed modified JMF on Form CEM-3511.
2. Mix design records on Form CEM-3512 for the accepted JMF to be modified.
3. JMF verification on Form CEM-3513 for the accepted JMF to be modified.
4. Quality characteristics test results for the modified JMF as specified in section 39-1.03B. Perform tests at the mix design OBC as shown on Form CEM-3512.
5. If required, California Test 371 test results for the modified JMF.

With an accepted modified JMF submittal, the Engineer verifies each modified JMF within 5 business days of receiving all verification samples. If California Test 371 is required, the Engineer tests for California Test 371 within 10 days of receiving verification samples.

The Engineer verifies the modified JMF after the modified JMF HMA is placed on the project and verification samples are taken within the first 750 tons following sampling requirements in Section 39-1.03E, "Job Mix Formula Verification." The Engineer tests verification samples for compliance with:

1. Stability as shown in the table titled "Hot Mix Asphalt Mix Design Requirements"
2. Air void content at design value  $\pm 2.0$  percent
3. Voids in mineral aggregate as shown in the table titled "Hot Mix Asphalt Mix Design Requirements"
4. Voids filled with asphalt if an adjustment for asphalt binder content TV is more than  $\pm 0.3$  percent from the original OBC shown on Form CEM-3512.
5. Dust proportion if an adjustment for asphalt binder content TV is more than  $\pm 0.3$  percent from OBC shown on Form CEM-3512.

If the modified JMF is verified, the Engineer revises your Form CEM-3513 to include the new binder source. Your revised Form CEM-3513 will have the same expiration date as the original Form CEM-3513 for the accepted JMF that is modified.

If a modified JMF is not verified, stop production and any HMA placed using the modified JMF is rejected.

The Engineer deducts \$2,000 from payments for each modified JMF verification. The Engineer deducts an additional \$2,000 from payments for each modified JMF verification that requires California Test 371.

### **39-1.03H Job Mix Formula Acceptance**

You may start HMA production if:

1. The Engineer's review of the JMF shows compliance with the specifications.
2. The Department has verified the JMF within 12 months before HMA production.
3. The Engineer accepts the verified JMF.

## **39-1.04 CONTRACTOR QUALITY CONTROL**

### **39-1.04A General**

Establish, maintain, and change a quality control system to ensure materials and work comply with the specifications. Submit quality control test results to the Engineer within 3 business days of a request except when QC / QA is specified.

You must identify the HMA sampling location in your Quality Control Plan. During production, take samples under California Test 125. You may sample HMA from:

1. The plant
2. The truck
3. A windrow
4. The paver hopper
5. The mat behind the paver

### **39-1.04B Prepaving Conference**

Meet with the Engineer at a prepaving conference at a mutually agreed time and place. Discuss methods of performing the production and paving work.

### **39-1.04C Asphalt Rubber Binder**

Take asphalt rubber binder samples from the feed line connecting the asphalt rubber binder tank to the HMA plant. Sample and test asphalt rubber binder under Laboratory Procedure LP-11.

Test asphalt rubber binder for compliance with the viscosity specifications in Section 39-1.02, "Materials." During asphalt rubber binder production and HMA production using asphalt rubber binder, measure viscosity every hour with not less than 1 reading for each asphalt rubber binder batch. Log measurements with corresponding time and asphalt rubber binder temperature. Submit the log daily in writing.

Submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance." With the Certificate of Compliance, submit test results in writing for CRM and asphalt modifier with each truckload delivered to the HMA plant. A Certificate of Compliance for asphalt modifier must not represent more than 5,000 pounds. Use an AASHTO-certified laboratory for testing.

Sample and test gradation and wire and fabric content of CRM once per 10,000 pounds of scrap tire CRM and once per 3,400 pounds of high natural CRM. Sample and test scrap tire CRM and high natural CRM separately.

Submit certified weight slips in writing for the CRM and asphalt modifier furnished.

### **39-1.04D Aggregate**

Determine the aggregate moisture content and RAP moisture content in continuous mixing plants at least twice a day during production and adjust the plant controller. Determine the RAP moisture content in batch mixing plants at least twice a day during production and adjust the plant controller.

### **39-1.04E Reclaimed Asphalt Pavement**

Perform RAP quality control testing each day.

Sample RAP once daily and determine the RAP aggregate gradation under Laboratory Procedure LP-9 and submit the results to the Engineer in writing with the combined aggregate gradation.

### **39-1.04F Density Cores**

To determine density for Standard and QC / QA projects, take 4-inch or 6-inch diameter density cores at least once every 5 business days. Take 1 density core for every 250 tons of HMA from random locations the Engineer designates. Take density cores in the Engineer's presence and backfill and compact holes with material authorized by the Engineer. Before submitting a density core to the Engineer, mark it with the density core's location and place it in a protective container.

If a density core is damaged, replace it with a density core taken within 1 foot longitudinally from the original density core. Relocate any density core located within 1 foot of a rumble strip to 1 foot transversely away from the rumble strip.

### **39-1.04G Briquettes**

Prepare 3 briquettes for each stability and air voids content determination. Report the average of 3 tests. Prepare new briquettes and test if the range of stability for the 3 briquettes is more than 12 points.

You may use the briquettes used for stability testing to determine bulk specific gravity under CT 308. If you use these briquettes and tests using bulk specific gravity fail, you may prepare 3 new briquettes and determine a new bulk specific gravity.

### **39-1.05 ENGINEER'S ACCEPTANCE**

The Engineer's acceptance of HMA is specified in the sections for each HMA construction process.

The Engineer samples materials for testing under California Test 125 and the applicable test method except samples may be taken from:

1. The plant from:
  - 1.1. A truck
  - 1.2. An automatic sampling device
2. The mat behind the paver

Sampling must be independent of Contractor quality control, statistically-based, and random. If you request, the Engineer splits samples and provides you with a part.

The Engineer accepts HMA based on:

1. Accepted JMF
2. Accepted QCP for Standard and QC / QA
3. Compliance with the HMA Acceptance tables
4. Acceptance of a lot for QC / QA
5. Visual inspection

The Engineer prepares 3 briquettes for each stability and air voids content determination. The Engineer reports the average of 3 tests. The Engineer prepares new briquettes and test if the range of stability for the 3 briquettes is more than 8 points.

The Engineer may use the briquettes used for stability testing to determine bulk specific gravity under CT 308. If the Engineer uses the same briquettes and the tests using bulk specific gravity fail, the Engineer prepares 3 new briquettes and determines a new bulk specific gravity.

### **39-1.06 DISPUTE RESOLUTION**

You and the Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result discrepancies. Notify the Engineer in writing within 5 business days of receiving a test result if you dispute the test result.

If you or the Engineer dispute each other's test results, submit written quality control test results and copies of paperwork including worksheets used to determine the disputed test results to the Engineer. An Independent Third Party (ITP) performs referee testing. Before the ITP participates in a dispute resolution, the ITP must be accredited under the Department's Independent Assurance Program. The ITP must be independent of the project. By mutual agreement, the ITP is chosen from:

1. A Department laboratory
2. A Department laboratory in a district or region not in the district or region the project is located
3. The Transportation Laboratory
4. A laboratory not currently employed by you or your HMA producer

If split quality control or acceptance samples are not available, the ITP uses any available material representing the disputed HMA for evaluation.



### **39-1.07 PRODUCTION START-UP EVALUATION**

The Engineer evaluates HMA production and placement at production start-up.

Within the first 750 tons produced on the first day of HMA production, in the Engineer's presence and from the same production run, take samples of:

1. Aggregate
2. Asphalt binder
3. RAP
4. HMA

Sample aggregate from cold feed belts or hot bins. Take RAP samples from the RAP system. Sample HMA under California Test 125 except if you request in writing and the Engineer approves, you may sample HMA from:

1. The plant
2. The truck
3. A windrow
4. The paver hopper
5. The mat behind the paver

For aggregate, RAP, and HMA, split the samples into at least 4 parts and label their containers. Submit 3 split parts to the Engineer and keep 1 part.

For Standard and QC / QA projects, you and the Engineer must test the split samples and report test results in writing within 3 business days of sampling. If you proceed before receipt of the test results, the Engineer may consider the HMA placed to be represented by these test results.

For Standard and QC / QA projects, take 4-inch or 6-inch diameter density cores within the first 750 tons on the first day of HMA production. For each density core, the Engineer reports the bulk specific gravity determined under California Test 308, Method A in addition to the percent of maximum theoretical density. You may test for in-place density at the density core locations and include them in your production tests for percent of maximum theoretical density.

### **39-1.08 PRODUCTION**

#### **39-1.08A General**

Produce HMA in a batch mixing plant or a continuous mixing plant. Proportion aggregate by hot or cold feed control.

HMA plants must be Department-qualified. Before production, the HMA plant must have a current qualification under the Department's Materials Plant Quality Program.

During production, you may adjust:

1. Hot or cold feed proportion controls for virgin aggregate and RAP
2. The set point for asphalt binder content

#### **39-1.08B Mixing**

Mix HMA ingredients into a homogeneous mixture of coated aggregates.

Asphalt binder must be between 275 °F and 375 °F when mixed with aggregate.

Asphalt rubber binder must be between 375 °F and 425 °F when mixed with aggregate.

When mixed with asphalt binder, aggregate must not be more than 325 °F except aggregate for OGFC with unmodified asphalt binder must be not more than 275 °F. Aggregate temperature specifications do not apply when you use RAP.

HMA with or without RAP must not be more than 325 °F.

#### **39-1.08C Asphalt Rubber Binder**

Deliver scrap tire CRM and high natural CRM in separate bags.

Either proportion and mix asphalt binder, asphalt modifier, and CRM simultaneously or premix the asphalt binder and asphalt modifier before adding CRM. If you premix asphalt binder and asphalt modifier, asphalt binder must be from 375 to 425 degrees F when you add the asphalt modifier. Mix them for at least 20 minutes. When you add CRM, the asphalt binder and asphalt modifier must be between 375 °F and 425 °F.

Do not use asphalt rubber binder during the first 45 minutes of the reaction period. During this period, the asphalt rubber binder mixture must be between 375 °F and the lower of 425 °F or 25 °F below the asphalt binder's flash point indicated in the MSDS.

If any asphalt rubber binder is not used within 4 hours after the reaction period, discontinue heating. If the asphalt rubber binder drops below 375 °F, reheat before use. If you add more scrap tire CRM to the reheated asphalt rubber binder, the binder must undergo a 45-minute reaction period. The added scrap tire CRM must not exceed 10 percent of the total asphalt rubber binder weight. Reheated and reacted asphalt rubber binder must comply with the viscosity specifications for asphalt rubber binder in Section 39-1.02, "Materials." Do not reheat asphalt rubber binder more than twice.

### **39-1.09 SUBGRADE, TACK COAT, AND GEOSYNTHETIC PAVEMENT INTERLAYER**

#### **39-1.09A General**

Prepare subgrade or apply tack coat to surfaces receiving HMA. If specified, place geosynthetic pavement interlayer over a coat of asphalt binder.

#### **39-1.09B Subgrade**

Subgrade to receive HMA must comply with the compaction and elevation tolerance specifications in the sections for the material involved. Subgrade must be free of loose and extraneous material. If HMA is paved on existing base or pavement, remove loose paving particles, dirt, and other extraneous material by any means including flushing and sweeping.

#### **39-1.09C Tack Coat**

Apply tack coat:

1. To existing pavement including planed surfaces
2. Between HMA layers
3. To vertical surfaces of:
  - 3.1. Curbs
  - 3.2. Gutters
  - 3.3. Construction joints

Before placing HMA, apply tack coat in 1 application at the minimum residual rate specified for the condition of the underlying surface:

**Tack Coat Application Rates for HMA Type A, Type B, and RHMA-G**

| HMA over:                          | Minimum Residual Rates (gallons per square yard)                   |  |   |
|------------------------------------|--|--|---|
|                                    | CSS1/CSS1h,<br>SS1/SS1h and<br>QS1h/CQS1h<br>Asphaltic<br>Emulsion | CRS1/CRS2,<br>RS1/RS2 and<br>QS1/CQS1<br>Asphaltic<br>Emulsion | Asphalt Binder and<br>PMRS2/PMCRS2<br>and<br>PMRS2h/PMCRS2h<br>Asphaltic Emulsion |
| New HMA (between layers)           | 0.02   | 0.03   | 0.02  |
| PCC and existing HMA (AC) surfaces | 0.03   | 0.04   | 0.03  |
| Planed PCC and HMA (AC) surfaces   | 0.05   | 0.06   | 0.04  |

### Tack Coat Application Rates for OGFC

| OGFC over:                            | Minimum Residual Rates (gallons per square yard)                   |  |   |
|---------------------------------------|--|--|---|
|                                       | CSS1/CSS1h,<br>SS1/SS1h and<br>QS1h/CQS1h<br>Asphaltic<br>Emulsion | CRS1/CRS2,<br>RS1/RS2 and<br>QS1/CQS1<br>Asphaltic<br>Emulsion | Asphalt Binder and<br>PMRS2/PMCRS2<br>and<br>PMRS2h/PMCRS2h<br>Asphaltic Emulsion |
| New HMA                               | 0.03   | 0.04   | 0.03  |
| PCC and existing HMA (AC)<br>surfaces | 0.05   | 0.06   | 0.04  |
| Planed PCC and HMA (AC)<br>surfaces   | 0.06   | 0.07   | 0.05  |

If you dilute asphaltic emulsion, mix until homogeneous before application.

Apply to vertical surfaces with a residual tack coat rate that will thoroughly coat the vertical face without running off.

If you request in writing and the Engineer authorizes, you may:

1. Change tack coat rates
2. Omit tack coat between layers of new HMA during the same work shift if:
  - 2.1. No dust, dirt, or extraneous material is present
  - 2.2. The surface is at least 140 °F

Immediately in advance of placing HMA, apply additional tack coat to damaged areas or where loose or extraneous material is removed.

Close areas receiving tack coat to traffic. Do not track tack coat onto pavement surfaces beyond the job site.

Asphalt binder tack coat must be between 285 °F and 350 °F when applied.

### 39-1.09D Geosynthetic Pavement Interlayer

Place geosynthetic pavement interlayer in compliance with the manufacturer's recommendations.

Before placing the geosynthetic pavement interlayer and asphalt binder:

1. Repair cracks 1/4 inch and wider, spalls, and holes in the pavement. The State pays for this repair work under Section 4-1.03D, "Extra Work."
2. Clean the pavement of loose and extraneous material.

Immediately before placing the interlayer, apply 0.25 gallon  $\pm$  0.03 gallon of asphalt binder per square yard of interlayer or until the fabric is saturated. Apply asphalt binder the width of the geosynthetic pavement interlayer plus 3 inches on each side. At interlayer overlaps, apply asphalt binder on the lower interlayer the same overlap distance as the upper interlayer.

Asphalt binder must be from 285 °F to 350 °F and below the minimum melting point of the geosynthetic pavement interlayer when applied.

Align and place the interlayer with no overlapping wrinkles, except a wrinkle that overlaps may remain if it is less than 1/2 inch thick. If the overlapping wrinkle is more than 1/2 inch thick, cut the wrinkle out and overlap the interlayer no more than 2 inches.

The minimum HMA thickness over the interlayer must be 0.12 foot thick including conform tapers. Do not place the interlayer on a wet or frozen surface.

Overlap the interlayer borders between 2 inches and 4 inches. In the direction of paving, overlap the following roll with the preceding roll at any break.

You may use rolling equipment to correct distortions or wrinkles in the interlayer.

If asphalt binder tracked onto the interlayer or brought to the surface by construction equipment causes interlayer displacement, cover it with a small quantity of HMA.

Before placing HMA on the interlayer, do not expose the interlayer to:

1. Traffic except for crossings under traffic control and only after you place a small HMA quantity
2. Sharp turns from construction equipment
3. Damaging elements

Pave HMA on the interlayer during the same work shift.

### **39-1.10 SPREADING AND COMPACTING EQUIPMENT**

Paving equipment for spreading must be:

1. Self-propelled
2. Mechanical
3. Equipped with a screed or strike-off assembly that can distribute HMA the full width of a traffic lane
4. Equipped with a full-width compacting device
5. Equipped with automatic screed controls and sensing devices that control the thickness, longitudinal grade, and transverse screed slope

Install and maintain grade and slope references.

The screed must produce a uniform HMA surface texture without tearing, shoving, or gouging.

The paver must not leave marks such as ridges and indentations unless you can eliminate them by rolling.

Rollers must be equipped with a system that prevents HMA from sticking to the wheels. You may use a parting agent that does not damage the HMA or impede the bonding of layers.

In areas inaccessible to spreading and compacting equipment:

1. Spread the HMA by any means to obtain the specified lines, grades and cross sections.
2. Use a pneumatic tamper, plate compactor, or equivalent to achieve thorough compaction.

### **39-1.11 TRANSPORTING, SPREADING, AND COMPACTING**

Do not pave HMA on a wet pavement or frozen surface.

You may deposit HMA in a windrow and load it in the paver if:

1. Paver is equipped with a hopper that automatically feeds the screed
2. Loading equipment can pick up the windrowed material and deposit it in the paver hopper without damaging base material
3. Activities for deposit, pick-up, loading, and paving are continuous
4. HMA temperature in the windrow does not fall below 260 °F

You may pave HMA in 1 or more layers on areas less than 5 feet wide and outside the traveled way including shoulders. You may use mechanical equipment other than a paver for these areas. The equipment must produce a uniform smoothness and texture.

HMA handled, spread, or windrowed must not stain the finished surface of any improvement including pavement.

Do not use petroleum products such as kerosene or diesel fuel to release HMA from trucks, spreaders, or compactors.

HMA must be free of:

1. Segregation
2. Coarse or fine aggregate pockets
3. Hardened lumps

Longitudinal joints in the top layer must match specified lane edges. Alternate longitudinal joint offsets in lower layers at least 0.5 foot from each side of the specified lane edges. You may request in writing other longitudinal joint placement patterns.

Until the adjoining through lane's top layer has been paved, do not pave the top layer of:

1. Shoulders
2. Tapers
3. Transitions
4. Road connections
5. Driveways
6. Curve widenings
7. Chain control lanes

8. Turnouts
9. Turn pockets

If the number of lanes change, pave each through lane's top layer before paving a tapering lane's top layer. Simultaneous to paving a through lane's top layer, you may pave an adjoining area's top layer including shoulders. Do not operate spreading equipment on any area's top layer until completing final compaction.

If HMA (leveling) is specified, fill and level irregularities and ruts with HMA before spreading HMA over base, existing surfaces, or bridge decks. You may use mechanical equipment other than a paver for these areas. The equipment must produce a uniform smoothness and texture. HMA used to change an existing surface's cross slope or profile is not HMA (leveling).

If placing HMA against the edge of existing pavement, sawcut or grind the pavement straight and vertical along the joint and remove extraneous material without damaging the surface remaining in place. If placing HMA against the edge of a longitudinal or transverse construction joint and the joint is damaged or not placed to a neat line, sawcut or grind the pavement straight and vertical along the joint and remove extraneous material without damaging the surface remaining in place. Repair or remove and replace damaged pavement at your expense.

Rolling must leave the completed surface compacted and smooth without tearing, cracking, or shoving. Complete finish rolling activities before the pavement surface temperature is:

1. Below 150 °F for HMA with unmodified binder
2. Below 140 °F for HMA with modified binder
3. Below 200 °F for RHMA-G

If a vibratory roller is used as a finish roller, turn the vibrator off.

Do not use a pneumatic tired roller to compact RHMA-G.

For Standard and QC/QA, if a 3/4-inch aggregate grading is specified, you may use a 1/2-inch aggregate grading if the specified total paved thickness is at least 0.15 foot and less than 0.20 foot thick.

Spread and compact HMA under Section 39-3.03, "Spreading and Compacting Equipment," and Section 39-3.04, "Transporting, Spreading, and Compacting," for any of the following:

1. Specified paved thickness is less than 0.15 foot.
2. Specified paved thickness is less than 0.20 foot and a 3/4-inch aggregate grading is specified and used.
3. You spread and compact at:
  - 3.1. Asphalt concrete surfacing replacement areas
  - 3.2. Leveling courses
  - 3.3. Areas the Engineer determines conventional compaction and compaction measurement methods are impeded

Do not open new HMA pavement to public traffic until its mid-depth temperature is below 160 °F.

If you request in writing and the Engineer authorizes, you may cool HMA Type A and Type B with water when rolling activities are complete. Apply water under Section 17, "Watering."

Spread sand at a rate between 1 pound and 2 pounds per square yard on new RHMA-G, RHMA-O, and RHMA-O-HB pavement when finish rolling is complete. Sand must be free of clay or organic matter. Sand must comply with Section 90-3.03, "Fine Aggregate Grading." Keep traffic off the pavement until spreading sand is complete.

### **39-1.12 SMOOTHNESS**

#### **39-1.12A General**

Determine HMA smoothness with a profilograph and a straightedge.

Smoothness specifications do not apply to OGFC placed on existing pavement not constructed under the same project.

If portland cement concrete is placed on HMA:

1. Cold plane the HMA finished surface to within specified tolerances if it is higher than the grade specified by the Engineer.
2. Remove and replace HMA if the finished surface is lower than 0.05 foot below the grade specified by the Engineer.

### **39-1.12B Straightedge**

The HMA pavement top layer must not vary from the lower edge of a 12-foot long straightedge:

1. More than 0.01 foot when the straight edge is laid parallel with the centerline
2. More than 0.02 foot when the straightedge is laid perpendicular to the centerline and extends from edge to edge of a traffic lane
3. More than 0.02 foot when the straightedge is laid within 24 feet of a pavement conform

### **39-1.12C Profilograph**

Under California Test 526, determine the zero (null) blanking band Profile Index ( $PI_0$ ) and must-grinds on the top layer of HMA Type A, Type B, and RHMA-G pavement. Take 2 profiles within each traffic lane, 3 feet from and parallel with the edge of each lane.

A must-grind is a deviation of 0.3 inch or more in a length of 25 feet. You must correct must-grinds.

For OGFC, only determine must-grinds when placed over HMA constructed under the same project. The top layer of the underlying HMA must comply with the smoothness specifications before placing OGFC.

Profile pavement in the Engineer's presence. Choose the time of profiling.

On tangents and horizontal curves with a centerline radius of curvature 2,000 feet or more, the  $PI_0$  must be at most 2.5 inches per 0.1-mile section.

On horizontal curves with a centerline radius of curvature between 1,000 feet and 2,000 feet including pavement within the superelevation transitions, the  $PI_0$  must be at most 5 inches per 0.1-mile section.

Before the Engineer accepts HMA pavement for smoothness, submit written final profilograms.

Submit 1 electronic copy of profile information in Microsoft Excel and 1 electronic copy of longitudinal pavement profiles in ".erd" format or other ProVAL compatible format to the Engineer and to:

Smoothness@dot.ca.gov

The following HMA pavement areas do not require a  $PI_0$ . You must measure these areas with a 12-foot straightedge and determine must-grinds with a profilograph:

1. New HMA with a total thickness less than 0.25 foot
2. HMA sections of city or county streets and roads, turn lanes and collector lanes that are less than 1,500 feet in length

The following HMA pavement areas do not require a  $PI_0$ . You must measure these areas with a 12-foot straightedge:

1. Horizontal curves with a centerline radius of curvature less than 1,000 feet including pavement within the superelevation transitions of those curves
2. Within 12 feet of a transverse joint separating the pavement from:
  - 2.1. Existing pavement not constructed under the same project
  - 2.2. A bridge deck or approach slab
3. Exit ramp termini, truck weigh stations, and weigh-in-motion areas
4. If steep grades and superelevation rates greater than 6 percent are present on:
  - 4.1. Ramps
  - 4.2. Connectors
5. Turn lanes
6. Areas within 15 feet of manholes or drainage transitions
7. Acceleration and deceleration lanes for at-grade intersections
8. Shoulders and miscellaneous areas
9. HMA pavement within 3 feet from and parallel to the construction joints formed between curbs, gutters, or existing pavement

### **39-1.12D Smoothness Correction**

If the top layer of HMA Type A, Type B, or RHMA-G pavement does not comply with the smoothness specifications, grind the pavement to within tolerances, remove and replace it, or place a layer of HMA. The Engineer must authorize your choice of correction before the work begins.

Remove and replace the areas of OGFC not in compliance with the must-grind and straightedge specifications, except you may grind OGFC for correcting smoothness:

1. At a transverse joint separating the pavement from pavement not constructed under the same project
2. Within 12 feet of a transverse joint separating the pavement from a bridge deck or approach slab

Corrected HMA pavement areas must be uniform rectangles with edges:

1. Parallel to the nearest HMA pavement edge or lane line
2. Perpendicular to the pavement centerline

Measure the corrected HMA pavement surface with a profilograph and a 12-foot straightedge and correct the pavement to within specified tolerances. If a must-grind area or straightedged pavement cannot be corrected to within specified tolerances, remove and replace the pavement.

On ground areas not overlaid with OGFC, apply fog seal coat under Section 37-1, "Seal Coats."

### **39-1.13 MISCELLANEOUS AREAS AND DIKES**

Miscellaneous areas are outside the traveled way and include:

1. Median areas not including inside shoulders
2. Island areas
3. Sidewalks
4. Gutters
5. Gutter flares
6. Ditches
7. Overside drains
8. Aprons at the ends of drainage structures

Spread miscellaneous areas in 1 layer and compact to the specified lines and grades.

For miscellaneous areas and dikes:

1. Do not submit a JMF.
2. Choose the 3/8-inch or 1/2-inch HMA Type A and Type B aggregate gradations.
3. Minimum asphalt binder content must be 6.8 percent for 3/8-inch aggregate and 6.0 percent for 1/2-inch aggregate. If you request in writing and the Engineer authorizes, you may reduce the minimum asphalt binder content.
4. Choose asphalt binder Grade PG 70-10 or the same grade specified for HMA.

## **39-2 STANDARD**

### **39-2.01 DESCRIPTION**

If HMA is specified as Standard, construct it under Section 39-1, "General," this Section 39-2, "Standard," and Section 39-5, "Measurement and Payment."

### **39-2.02 CONTRACTOR QUALITY CONTROL**

#### **39-2.02A Quality Control Plan**

Establish, implement, and maintain a Quality Control Plan (QCP) for HMA. The QCP must describe the organization and procedures you will use to:

1. Control the quality characteristics
2. Determine when corrective actions are needed (action limits)
3. Implement corrective actions

When you submit the proposed JMF, submit the written QCP. You and the Engineer must discuss the QCP during the prepaving conference.

The QCP must address the elements affecting HMA quality including:

1. Aggregate
2. Asphalt binder
3. Additives
4. Production
5. Paving

The Engineer reviews each QCP within 5 business days from the submittal. Hold HMA production until the Engineer accepts the QCP in writing. The Engineer's QCP acceptance does not mean your compliance with the QCP will result in acceptable HMA. Section 39-1.05, "Engineer's Acceptance," specifies HMA acceptance.

#### **39-2.02B Quality Control Testing**

Perform sampling and testing at the specified frequency for the following quality characteristics:



**Minimum Quality Control – Standard**

| Quality Characteristic  | Test Method          | Minimum Sampling and Testing Frequency                            | HMA Type                     |                              |                              |                              |
|---|----------------------|---|------------------------------|------------------------------|------------------------------|------------------------------|
|   |                      |   | A                            | B                            | RHMA-G                       | OGFC                         |
| Aggregate gradation <sup>a</sup>  | CT 202               | 1 per 750 tons and any remaining part at the end of the project   | JMF ± Tolerance <sup>b</sup> | JMF ± Tolerance <sup>b</sup> | JMF ± Tolerance <sup>b</sup> | JMF ± Tolerance <sup>b</sup> |
| Sand equivalent (min.) <sup>c</sup>   | CT 217               |   | 47                           | 42                           | 47                           | --                           |
| Asphalt binder content (%)  | CT 379 or 382        |   | JMF ± 0.45                   | JMF ± 0.45                   | JMF ± 0.50                   | JMF ± 0.50                   |
| HMA moisture content (% , max.)   | CT 226 or CT 370     | 1 per 2,500 tons but not less than 1 per paving day               | 1.0                          | 1.0                          | 1.0                          | 1.0                          |
| Field compaction, (% , max. theoretical density) <sup>d,e</sup>   | Quality control plan | 2 per business day (min.)   | 91 - 97                      | 91 - 97                      | 91 - 97                      | --                           |
| Stabilometer value (min.) <sup>c, f</sup><br>No. 4 and 3/8" gradings<br>1/2" and 3/4" gradings  | CT 366               | One per 4,000 tons or 2 per 5 business days, whichever is more    | 30                           | 30                           | --                           | --                           |
|   |                      |   | 37                           | 35                           | 23                           | --                           |
| Air voids content (%) <sup>c, g</sup>   | CT 367               |   | 4 ± 2                        | 4 ± 2                        | Specification ± 2            | --                           |
| Aggregate moisture content at continuous mixing plants and RAP moisture content at continuous mixing plants and batch mixing plants <sup>h</sup>  | CT 226 or CT 370     | 2 per day during production                                       | --                           | --                           | --                           | --                           |
| Percent of crushed particles coarse aggregate (% , min.)<br>One fractured face<br>Two fractured faces<br>Fine aggregate (% , min)<br>(Passing No. 4 sieve and retained on No. 8 sieve.)<br>One fractured face | CT 205               | As necessary and designated in the QCP. At least once per project | 90                           | 25                           | --                           | 90                           |
|   |                      |   | 75                           | --                           | 90                           | 75                           |
|   |                      |   | 70                           | 20                           | 70                           | 90                           |
| Los Angeles Rattler (% , max.)<br>Loss at 100 rev.<br>Loss at 500 rev.  | CT 211               |   | 12<br>45                     | --<br>50                     | 12<br>40                     | 12<br>40                     |

|   |                  |                  |  |  |  |                                     |
|---|------------------|------------------|--|--|--|-------------------------------------|
| Flat and elongated particles (% max. by weight @ 5:1)   | CT 235           |                  | Report only  | Report only  | Report only  | Report only                         |
| Fine aggregate angularity (% min.) <sup>i</sup>   | CT 234           |                  | 45   | 45   | 45   | --                                  |
| Voids filled with asphalt (%) <sup>j</sup><br>No. 4 grading<br>3/8" grading<br>1/2" grading<br>3/4" grading       | LP-3             |                  | 76.0 – 80.0<br>73.0 – 76.0<br>65.0 – 75.0<br>65.0 – 75.0 | 76.0 – 80.0<br>73.0 – 76.0<br>65.0 – 75.0<br>65.0 – 75.0 | Report only  | --                                  |
| Voids in mineral aggregate (% min.) <sup>j</sup><br>No. 4 grading<br>3/8" grading<br>1/2" grading<br>3/4" grading | LP-2             |                  | 17.0<br>15.0<br>14.0<br>13.0                             | 17.0<br>15.0<br>14.0<br>13.0                             | --<br>--<br>18.0 – 23.0 <sup>k</sup><br>18.0 – 23.0 <sup>k</sup> | --                                  |
| Dust proportion <sup>j</sup><br>No. 4 and 3/8" gradings<br>1/2" and 3/4" gradings                                 | LP-4             |                  | 0.9 – 2.0<br>0.6 – 1.3                                   | 0.9 – 2.0<br>0.6 – 1.3                                   | Report only  | --                                  |
| Smoothness  | Section 39-1.12  | --               | 12-foot straightedge, must-grind, and PI <sub>0</sub>    | 12-foot straightedge, must-grind, and PI <sub>0</sub>    | 12-foot straightedge, must-grind, and PI <sub>0</sub>            | 12-foot straightedge and must-grind |
| Asphalt rubber binder viscosity @ 375 °F, centipoises   | Section 39-1.02D | Section 39-1.04C | --   | --   | 1,500 – 4,000  | 1,500 – 4,000                       |
| Asphalt modifier  | Section 39-1.02D | Section 39-1.04C | --   | --   | Section 39-1.02D   | Section 39-1.02D                    |
| Crumb rubber modifier   | Section 39-1.02D | Section 39-1.04C | --   | --   | Section 39-1.02D   | Section 39-1.02D                    |

Notes:

<sup>a</sup> Determine combined aggregate gradation containing RAP under Laboratory Procedure LP-9.

<sup>b</sup> The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."

<sup>c</sup> Report the average of 3 tests from a single split sample.

<sup>d</sup> Determine field compaction for any of the following conditions:

1. 1/2-inch, 3/8-inch, No. 4 aggregate grading is used and the specified total paved thickness is at least 0.15 foot.

2. 3/4-inch aggregate grading is used and the specified total paved thickness is at least 0.20 foot.

<sup>e</sup> To determine field compaction use:

1. In-place density measurements using the method specified in your QC.

2. California Test 309 to determine maximum theoretical density at the frequency specified in California Test 375, Part 5C.

<sup>f</sup> Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F ± 5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."

<sup>g</sup> Determine the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.

<sup>h</sup> For adjusting the plant controller at the HMA plant.

<sup>i</sup> The Engineer waives this specification if HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

<sup>j</sup> Report only if the adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC.

<sup>k</sup> Voids in mineral aggregate for RHMA-G must be within this range.

For any single quality characteristic except smoothness, if 2 consecutive quality control test results do not comply with the action limits or specifications:

1. Stop production.
2. Notify the Engineer in writing.
3. Take corrective action.
4. Demonstrate compliance with the specifications before resuming production and placement on the State highway.

### **39-2.03 ENGINEER'S ACCEPTANCE**

#### **39-2.03A Testing**

The Engineer samples for acceptance testing and tests for:

**HMA Acceptance - Standard**

| Quality Characteristic                                       | Test Method      | HMA Type                        |                                 |   |                                     |
|--|------------------|---------------------------------|---------------------------------|---|-------------------------------------|
|  |                  | A                               | B                               | RHMA-G  | OGFC                                |
| Aggregate gradation <sup>a</sup>                             | CT 202           | JMF ±<br>Tolerance <sup>c</sup> | JMF ±<br>Tolerance <sup>c</sup> | JMF ±<br>Tolerance <sup>c</sup>                       | JMF ±<br>Tolerance <sup>c</sup>     |
| Sieve  |                  |                                 |                                 |   |                                     |
| 3/4"   |                  |                                 |                                 |   |                                     |
| 1/2"   |                  |                                 |                                 |   |                                     |
| 3/8"   |                  |                                 |                                 |   |                                     |
| No. 4  |                  |                                 |                                 |   |                                     |
| No. 8  | CT 217           | 47                              | 42                              | 47  | --                                  |
| No. 200  |                  |                                 |                                 |   |                                     |
| Sand equivalent (min.) <sup>d</sup>                          | CT 217           | 47                              | 42                              | 47  | --                                  |
| Asphalt binder content (%)                                   | CT 379 or 382    | JMF ± 0.45                      | JMF ± 0.45                      | JMF ± 0.50  | JMF ± 0.50                          |
| HMA moisture content (% max.)                                | CT 226 or CT 370 | 1.0                             | 1.0                             | 1.0   | 1.0                                 |
| Field compaction (% max. theoretical density) <sup>e,f</sup> | CT 375           | 91 – 97                         | 91 – 97                         | 91 – 97   | --                                  |
| Stabilometer value (min.) <sup>d,g</sup>                     | CT 366           | 30                              | 30                              | --  | --                                  |
| No. 4 and 3/8" gradings                                      |                  |                                 |                                 |   |                                     |
| 1/2" and 3/4" gradings                                       | CT 367           | 37                              | 35                              | 23  | --                                  |
| Air voids content (%) <sup>d,h</sup>                         |                  |                                 |                                 |   |                                     |
| Percent of crushed particles                                 | CT 205           | 4 ± 2                           | 4 ± 2                           | Specification ± 2                                     | --                                  |
| Coarse aggregate (% min.)                                    |                  |                                 |                                 |   |                                     |
| One fractured face   |                  |                                 |                                 |   |                                     |
| Two fractured faces  |                  |                                 |                                 |   |                                     |
| Fine aggregate (% min)                                       | CT 211           | 90                              | 25                              | --  | 90                                  |
| (Passing No. 4 sieve and retained on No. 8 sieve.)           |                  |                                 |                                 |   |                                     |
| One fractured face   |                  |                                 |                                 |   |                                     |
| Los Angeles Rattler (% max.)                                 |                  |                                 |                                 |   |                                     |
| Loss at 100 rev.   | CT 234           | 12                              | --                              | 12  | 12                                  |
| Loss at 500 rev.   |                  |                                 |                                 |   |                                     |
| Fine aggregate angularity (% min.) <sup>i</sup>              |                  |                                 |                                 |   |                                     |
| Flat and elongated particles (% max. by weight @ 5:1)        |                  |                                 |                                 |   |                                     |
| Voids filled with asphalt (%) <sup>j</sup>                   | LP-3             | Report only                     | Report only                     | Report only   | Report only                         |
| No. 4 grading  |                  |                                 |                                 |   |                                     |
| 3/8" grading   |                  |                                 |                                 |   |                                     |
| 1/2" grading   |                  |                                 |                                 |   |                                     |
| 3/4" grading   | LP-2             | 76.0 – 80.0                     | 76.0 – 80.0                     | Report only   | --                                  |
| Voids in mineral aggregate (% min.) <sup>j</sup>             |                  |                                 |                                 |   |                                     |
| No. 4 grading  |                  |                                 |                                 |   |                                     |
| 3/8" grading   |                  |                                 |                                 |   |                                     |
| 1/2" grading   | LP-4             | 17.0                            | 17.0                            | --  | --                                  |
| 3/4" grading   |                  |                                 |                                 |   |                                     |
| Dust proportion <sup>j</sup>                                 |                  |                                 |                                 |   |                                     |
| No. 4 and 3/8" gradings                                      |                  |                                 |                                 |   |                                     |
| 1/2" and 3/4" gradings                                       | Section 39-1.12  | 0.9 – 2.0                       | 0.9 – 2.0                       | 12-foot straightedge, must-grind, and PI <sub>0</sub> | 12-foot straightedge and must-grind |
| Smoothness   |                  |                                 |                                 |   |                                     |
| Asphalt binder   |                  |                                 |                                 |   |                                     |
| Asphalt rubber binder  |                  |                                 |                                 |   |                                     |

|                       |         |    |    |                                     |                                     |
|-----------------------|---------|----|----|-------------------------------------|-------------------------------------|
|                       |         |    |    | 1.02(C) and<br>Section 39-<br>1.02D | 1.02(C) and<br>Section 39-<br>1.02D |
| Asphalt modifier      | Various | -- | -- | Section 39-<br>1.02D                | Section 39-<br>1.02D                |
| Crumb rubber modifier | Various | -- | -- | Section 39-<br>1.02D                | Section 39-<br>1.02D                |

<sup>a</sup> The Engineer determines combined aggregate gradations containing RAP under Laboratory Procedure LP-9.

<sup>b</sup> "X" denotes the sieves the Engineer considers for the specified aggregate gradation.

<sup>c</sup> The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."

<sup>d</sup> The Engineer reports the average of 3 tests from a single split sample.

<sup>e</sup> The Engineer determines field compaction for any of the following conditions:

1. 1/2-inch, 3/8-inch, or No.4 aggregate grading is used and the specified total paved thickness is at least 0.15 foot.
2. 3/4-inch aggregate grading is used and the specified total paved thickness is at least 0.20 foot.

<sup>f</sup> To determined field compaction, the Engineer uses:

1. California Test 308, Method A, to determine in-place density of each density core.
2. California Test 309 to determine maximum theoretical density at the frequency specified in California Test 375, Part 5C.

<sup>g</sup> Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F  $\pm$  5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."

<sup>h</sup> The Engineer determines the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.

<sup>i</sup> The Engineer waives this specification if HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

<sup>j</sup> Report only if the adjustment for asphalt binder content target value is less than or equal to  $\pm$  0.3 percent from OBC.

<sup>k</sup> Voids in mineral aggregate for RHMA-G must be within this range.

No single test result may represent more than the smaller of 750 tons or 1 day's production.

For any single quality characteristic except smoothness, if 2 consecutive acceptance test results do not comply with the specifications:

1. Stop production.
2. Take corrective action.
3. In the Engineer's presence, take samples and split each sample into 4 parts. Test 1 part for compliance with the specifications and submit 3 parts to the Engineer. The Engineer tests 1 part for compliance with the specifications and reserves and stores 2 parts.
4. Demonstrate compliance with the specifications before resuming production and placement on the State highway.

The Engineer tests the density core you take from each 250 tons of HMA production. The Engineer determines the percent of maximum theoretical density for each density core by determining the density core's density and dividing by the maximum theoretical density.

The Engineer determines the percent of maximum theoretical density from density cores taken from the final layer measured the full depth of the total paved HMA thickness if any of the following applies:

1. 1/2-inch, 3/8-inch, or No. 4 aggregate grading is used and the specified total paved thickness is at least 0.15 foot and any layer is less than 0.15 foot.
2. 3/4-inch aggregate grading is used and the specified total paved thickness is at least 0.20 foot and any layer is less than 0.20 foot.

For percent of maximum theoretical density, the Engineer determines a deduction for each test result outside the specifications in compliance with:

**Reduced Payment Factors for Percent of Maximum Theoretical Density**

| HMA Type A and B<br>and RHMA-G<br>Percent of Maximum<br>Theoretical Density | Reduced Payment<br>Factor | HMA Type A and B<br>and RHMA-G<br>Percent of Maximum<br>Theoretical Density | Reduced Payment<br>Factor |
|---|---------------------------|---|---------------------------|
| 91.0  | 0.0000                    | 97.0  | 0.0000                    |
| 90.9  | 0.0125                    | 97.1  | 0.0125                    |
| 90.8  | 0.0250                    | 97.2  | 0.0250                    |
| 90.7  | 0.0375                    | 97.3  | 0.0375                    |
| 90.6  | 0.0500                    | 97.4  | 0.0500                    |
| 90.5  | 0.0625                    | 97.5  | 0.0625                    |
| 90.4  | 0.0750                    | 97.6  | 0.0750                    |
| 90.3  | 0.0875                    | 97.7  | 0.0875                    |
| 90.2  | 0.1000                    | 97.8  | 0.1000                    |
| 90.1  | 0.1125                    | 97.9  | 0.1125                    |
| 90.0  | 0.1250                    | 98.0  | 0.1250                    |
| 89.9  | 0.1375                    | 98.1  | 0.1375                    |
| 89.8  | 0.1500                    | 98.2  | 0.1500                    |
| 89.7  | 0.1625                    | 98.3  | 0.1625                    |
| 89.6  | 0.1750                    | 98.4  | 0.1750                    |
| 89.5  | 0.1875                    | 98.5  | 0.1875                    |
| 89.4  | 0.2000                    | 98.6  | 0.2000                    |
| 89.3  | 0.2125                    | 98.7  | 0.2125                    |
| 89.2  | 0.2250                    | 98.8  | 0.2250                    |
| 89.1  | 0.2375                    | 98.9  | 0.2375                    |
| 89.0  | 0.2500                    | 99.0  | 0.2500                    |
| < 89.0  | Remove and Replace        | > 99.0  | Remove and Replace        |

**39-2.04 TRANSPORTING, SPREADING, AND COMPACTING**

Determine the number of rollers needed to obtain the specified density and surface finish.

**39-3 METHOD**

**39-3.01 DESCRIPTION**

If HMA is specified as Method, construct it under Section 39-1, "General," this Section 39-3, "Method," and Section 39-5, "Measurement and Payment."

**39-3.02 ENGINEER'S ACCEPTANCE**

**39-3.02A Testing**

The Engineer samples for acceptance testing and tests for:

### HMA Acceptance - Method

| Quality Characteristic                                | Test Method      | HMA Type                            |                                     |                                     |                                     |
|---|------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
|   |                  | A                                   | B                                   | RHMA-G                              | OGFC                                |
| Aggregate gradation <sup>a</sup>                      | CT 202           | JMF ± Tolerance <sup>b</sup>        | JMF ± Tolerance <sup>b</sup>        | JMF ± Tolerance <sup>b</sup>        | JMF ± Tolerance <sup>b</sup>        |
| Sand equivalent (min.) <sup>c</sup>                   | CT 217           | 47                                  | 42                                  | 47                                  | --                                  |
| Asphalt binder content (%)                            | CT 379 or 382    | JMF ± 0.45                          | JMF ± 0.45                          | JMF ± 0.50                          | JMF ± 0.50                          |
| HMA moisture content (% max.)                         | CT 226 or CT 370 | 1.0                                 | 1.0                                 | 1.0                                 | 1.0                                 |
| Stabilometer value (min.) <sup>c,d</sup>              | CT 366           |                                     |                                     |                                     |                                     |
| No. 4 and 3/8" gradings                               |                  | 30                                  | 30                                  | --                                  | --                                  |
| 1/2" and 3/4" gradings                                |                  | 37                                  | 35                                  | 23                                  | --                                  |
| Percent of crushed particles                          | CT 205           |                                     |                                     |                                     |                                     |
| Coarse aggregate (% min.)                             |                  |                                     |                                     |                                     |                                     |
| One fractured face                                    |                  | 90                                  | 25                                  | --                                  | 90                                  |
| Two fractured faces                                   |                  | 75                                  | --                                  | 90                                  | 75                                  |
| Fine aggregate (% min.)                               |                  |                                     |                                     |                                     |                                     |
| (Passing No. 4 sieve and retained on No. 8 sieve.)    |                  |                                     |                                     |                                     |                                     |
| One fractured face                                    |                  | 70                                  | 20                                  | 70                                  | 90                                  |
| Los Angeles Rattler (% max.)                          | CT 211           |                                     |                                     |                                     |                                     |
| Loss at 100 rev.                                      |                  | 12                                  | --                                  | 12                                  | 12                                  |
| Loss at 500 rev.                                      |                  | 45                                  | 50                                  | 40                                  | 40                                  |
| Air voids content (%) <sup>c,e</sup>                  | CT 367           | 4 ± 2                               | 4 ± 2                               | Specification ± 2                   | --                                  |
| Fine aggregate angularity (% min.) <sup>f</sup>       | CT 234           | 45                                  | 45                                  | 45                                  | --                                  |
| Flat and elongated particles (% max. by weight @ 5:1) | CT 235           | Report only                         | Report only                         | Report only                         | Report only                         |
| Voids filled with asphalt (%) <sup>g</sup>            | LP-3             |                                     |                                     | Report only                         |                                     |
| No. 4 grading   |                  | 76.0 – 80.0                         | 76.0 – 80.0                         |                                     | --                                  |
| 3/8" grading  |                  | 73.0 – 76.0                         | 73.0 – 76.0                         |                                     |                                     |
| 1/2" grading  |                  | 65.0 – 75.0                         | 65.0 – 75.0                         |                                     |                                     |
| 3/4" grading  |                  | 65.0 – 75.0                         | 65.0 – 75.0                         |                                     |                                     |
| Voids in mineral aggregate (% min.) <sup>g</sup>      | LP-2             |                                     |                                     |                                     |                                     |
| No. 4 grading   |                  | 17.0                                | 17.0                                | --                                  | --                                  |
| 3/8" grading  |                  | 15.0                                | 15.0                                | --                                  |                                     |
| 1/2" grading  |                  | 14.0                                | 14.0                                | 18.0 – 23.0 <sup>h</sup>            |                                     |
| 3/4" grading  |                  | 13.0                                | 13.0                                | 18.0 – 23.0 <sup>h</sup>            |                                     |
| Dust proportion <sup>g</sup>                          | LP-4             |                                     |                                     | Report only                         |                                     |
| No. 4 and 3/8" gradings                               |                  | 0.9 – 2.0                           | 0.9 – 2.0                           |                                     | --                                  |
| 1/2" and 3/4" gradings                                |                  | 0.6 – 1.3                           | 0.6 – 1.3                           |                                     |                                     |
| Smoothness  | Section 39-1.12  | 12-foot straightedge and must-grind | 12-foot straightedge and must-grind | 12-foot straightedge and must-grind | 12-foot straightedge and must-grind |
| Asphalt binder  | Various          | Section 92                          | Section 92                          | Section 92                          | Section 92                          |
| Asphalt rubber binder                                 | Various          | --                                  | --                                  | Section 92-1.02(C) and Section 39-  | Section 92-1.02(C) and Section 39-  |

|                       |         |    |    |                  |                  |
|-----------------------|---------|----|----|------------------|------------------|
|                       |         |    |    | 1.02D            | 1.02D            |
| Asphalt modifier      | Various | -- | -- | Section 39-1.02D | Section 39-1.02D |
| Crumb rubber modifier | Various | -- | -- | Section 39-1.02D | Section 39-1.02D |

<sup>a</sup>The Engineer determines combined aggregate gradations containing RAP under Laboratory Procedure LP-9.

<sup>b</sup>The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."

<sup>c</sup>The Engineer reports the average of 3 tests from a single split sample.

<sup>d</sup>Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F ±5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."

<sup>e</sup>The Engineer determines the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.

<sup>f</sup>The Engineer waives this specification if HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

<sup>g</sup>Report only if the adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC.

<sup>h</sup>Voids in mineral aggregate for RHMA-G must be within this range.

No single test result may represent more than the smaller of 750 tons or 1 day's production.

For any single quality characteristic except smoothness, if 2 consecutive acceptance test results do not comply with the specifications:

1. Stop production.
2. Take corrective action.
3. In the Engineer's presence, take samples and split each sample into 4 parts. Test 1 part for compliance with the specifications and submit 3 parts to the Engineer. The Engineer tests 1 part for compliance with the specifications and reserves and stores 2 parts.
4. Demonstrate compliance with the specifications before resuming production and placement on the State highway.

### 39-3.03 SPREADING AND COMPACTING EQUIPMENT

Each paver spreading HMA Type A and Type B must be followed by 3 rollers:

1. One vibratory roller specifically designed to compact HMA. The roller must be capable of at least 2,500 vibrations per minute and must be equipped with amplitude and frequency controls. The roller's gross static weight must be at least 7.5 tons.
2. One oscillating type pneumatic-tired roller at least 4 feet wide. Pneumatic tires must be of equal size, diameter, type, and ply. The tires must be inflated to 60 psi minimum and maintained so that the air pressure does not vary more than 5 psi.
3. One steel-tired, 2-axle tandem roller. The roller's gross static weight must be at least 7.5 tons.

Each roller must have a separate operator. Rollers must be self-propelled and reversible.

Compact RHMA-G under the specifications for compacting HMA Type A and Type B except do not use pneumatic-tired rollers.

Compact OGFC with steel-tired, 2-axle tandem rollers. If placing over 300 tons of OGFC per hour, use at least 3 rollers for each paver. If placing less than 300 tons of OGFC per hour, use at least 2 rollers for each paver. Each roller must weigh between 126 pounds to 172 pounds per linear inch of drum width. Turn the vibrator off.

### 39-3.04 TRANSPORTING, SPREADING, AND COMPACTING

Pave HMA in maximum 0.25-foot thick compacted layers.

If the surface to be paved is both in sunlight and shade, pavement surface temperatures are taken in the shade.

Spread HMA Type A and Type B only if atmospheric and surface temperatures are:



### Minimum Atmospheric and Surface Temperatures

| Compacted Layer Thickness, feet | Minimum Atmospheric and Surface Temperatures |                                      |                           |                                      |
|---------------------------------|--|--------------------------------------|---------------------------|--------------------------------------|
|                                 | Atmospheric, ° F                             |                                      | Surface, ° F              |                                      |
|                                 | Unmodified Asphalt Binder                    | Modified Asphalt Binder <sup>a</sup> | Unmodified Asphalt Binder | Modified Asphalt Binder <sup>a</sup> |
| < 0.15                          | 55   | 50                                   | 60                        | 55                                   |
| 0.15 – 0.25                     | 45   | 45                                   | 50                        | 50                                   |

Note:

<sup>a</sup> Except asphalt rubber binder.

If the asphalt binder for HMA Type A and Type B is:

1. Unmodified asphalt binder, complete:

- 1.1. First coverage of breakdown compaction before the surface temperature drops below 250 °F
- 1.2. Breakdown and intermediate compaction before the surface temperature drops below 200 °F
- 1.3. Finish compaction before the surface temperature drops below 150 °F

2. Modified asphalt binder, complete:

- 2.1. First coverage of breakdown compaction before the surface temperature drops below 240 °F
- 2.2. Breakdown and intermediate compaction before the surface temperature drops below 180 °F
- 2.3. Finish compaction before the surface temperature drops below 140 °F

For RHMA-G:

1. Only spread and compact if the atmospheric temperature is at least 55 °F and the surface temperature is at least 60 °F.
2. Complete the first coverage of breakdown compaction before the surface temperature drops below 285 °F.
3. Complete breakdown and intermediate compaction before the surface temperature drops below 250 °F.
4. Complete finish compaction before the surface temperature drops below 200 °F.
5. If the atmospheric temperature is below 70 °F, cover loads in trucks with tarpaulins. The tarpaulins must completely cover the exposed load until you transfer the mixture to the paver's hopper or to the pavement surface.

For OGFC with unmodified asphalt binder:

1. Only spread and compact if the atmospheric temperature is at least 55 °F and the surface temperature is at least 60 °F.
2. Complete first coverage using 2 rollers before the surface temperature drops below 240 °F.
3. Complete all compaction before the surface temperature drops below 200 °F.
4. If the atmospheric temperature is below 70 °F, cover loads in trucks with tarpaulins. The tarpaulins must completely cover the exposed load until you transfer the mixture to the paver's hopper or to the pavement surface.

For OGFC with modified asphalt binder except asphalt rubber binder:

1. Only spread and compact if the atmospheric temperature is at least 50 °F and the surface temperature is at least 50 °F.
2. Complete first coverage using 2 rollers before the surface temperature drops below 240 °F.
3. Complete all compaction before the surface temperature drops below 180 °F.
4. If the atmospheric temperature is below 70 °F, cover loads in trucks with tarpaulins. The tarpaulins must completely cover the exposed load until you transfer the mixture to the paver's hopper or to the pavement surface.

For RHMA-O and RHMA-O-HB:

1. Only spread and compact if the atmospheric temperature is at least 55 °F and surface temperature is at least 60 °F.

2. Complete the 1st coverage using 2 rollers before the surface temperature drops below 280 °F.
3. Complete compaction before the surface temperature drops below 250 °F.
4. If the atmospheric temperature is below 70 °F, cover loads in trucks with tarpaulins. The tarpaulins must completely cover the exposed load until the mixture is transferred to the paver's hopper or to the pavement surface.

For RHMA-G and OGFC, tarpaulins are not required if the time from discharge to truck until transfer to the paver's hopper or the pavement surface is less than 30 minutes.

HMA compaction coverage is the number of passes needed to cover the paving width. A pass is 1 roller's movement parallel to the paving in either direction. Overlapping passes are part of the coverage being made and are not a subsequent coverage. Do not start a coverage until completing the prior coverage.

Start rolling at the lower edge and progress toward the highest part.

Perform breakdown compaction of each layer of HMA Type A, Type B, and RHMA-G with 3 coverages using a vibratory roller. The speed of the vibratory roller in miles per hour must not exceed the vibrations per minute divided by 1,000. If the HMA layer thickness is less than 0.08 foot, turn the vibrator off. The Engineer may order fewer coverages if the HMA layer thickness is less than 0.15 foot.

Perform intermediate compaction of each layer of HMA Type A and Type B with 3 coverages using a pneumatic-tired roller at a speed not to exceed 5 mph.

Perform finish compaction of HMA Type A, Type B, and RHMA-G with 1 coverage using a steel-tired roller.

Compact OGFC with 2 coverages using steel-tired rollers.

### **39-4 QUALITY CONTROL / QUALITY ASSURANCE**

#### **39-4.01 DESCRIPTION**

If HMA is specified as Quality Control / Quality Assurance, construct it under Section 39-1, "General," this Section 39-4, "Quality Control / Quality Assurance," and Section 39-5, "Measurement and Payment."

#### **39-4.02 GENERAL**

The QC / QA construction process consists of:

1. Establishing, maintaining, and changing if needed a quality control system providing assurance the HMA complies with the specifications
2. Sampling and testing at specified intervals, or sublots, to demonstrate compliance and to control process
3. The Engineer sampling and testing at specified intervals to verify testing process and HMA quality
4. The Engineer using test results, statistical evaluation of verified quality control tests, and inspection to accept HMA for payment

A lot is a quantity of HMA. The Engineer designates a new lot when:

1. 20 sublots are complete
2. The JMF changes
3. Production stops for more than 30 days

Each lot consists of no more than 20 sublots. A subplot is 750 tons except HMA paved at day's end greater than 250 tons is a subplot. If HMA paved at day's end is less than 250 tons, you may either make this quantity a subplot or include it in the previous subplot's test results for statistical evaluation.

#### **39-4.03 CONTRACTOR QUALITY CONTROL**

##### **39-4.03A General**

Use a composite quality factor,  $QF_C$ , and individual quality factors,  $QF_{QC_i}$ , to control your process and evaluate your quality control program. For quality characteristics without quality factors, use your quality control plan's action limits to control process.

Control HMA quality including:

1. Materials
2. Proportioning
3. Spreading and compacting
4. Finished roadway surface

Develop, implement, and maintain a quality control program that includes:

1. Inspection
2. Sampling
3. Testing

#### **39-4.03B Quality Control Plan**

With the JMF submittal, submit a written Quality Control Plan (QCP). The QCP must comply with the Department's Quality Control Manual for Hot Mix Asphalt Production and Placement. Discuss the QCP with the Engineer during the prepaving conference.

The Engineer reviews each QCP within 5 business days from the submittal. Hold HMA production until the Engineer accepts the QCP in writing. The Engineer's QCP acceptance does not mean your compliance with the QCP will result in acceptable HMA. Section 39-1.05, "Engineer's Acceptance," specifies HMA acceptance.

The QCP must include the name and qualifications of a Quality Control Manager. The Quality Control Manager administers the QCP and during paving must be at the job site within 3 hours of receiving notice. The Quality Control Manager must not be any of the following on the project:

1. Foreman
2. Production or paving crewmember
3. Inspector
4. Tester

The QCP must include action limits and details of corrective action you will take if a test result for any quality characteristic falls outside an action limit.

As work progresses, you must submit a written QCP supplement to change quality control procedures, personnel, tester qualification status, or laboratory accreditation status.

#### **39-4.03C Quality Control Inspection, Sampling, And Testing**

Sample, test, inspect, and manage HMA quality control.

Provide a roadway inspector while HMA paving activities are in progress. Provide a plant inspector during HMA production.

Inspectors must comply with the Department's Quality Control Manual for Hot Mix Asphalt Production and Placement.

Provide a testing laboratory and personnel for quality control testing. Provide the Engineer unrestricted access to the quality control activities. Before providing services for the project, the Engineer reviews, accredits, and qualifies the testing laboratory and personnel under the Department's Independent Assurance Program.

The minimum random sampling and testing for quality control is:

**Minimum Quality Control – QC / QA**

| Quality Characteristic   | Test Method      | Min-imum Sampling and Testing Frequen-cy            | HMA Type                     |                              |                              | Location of Sampling              | Max. Report-ing Time Allow-ance |
|--|------------------|---|------------------------------|------------------------------|------------------------------|-----------------------------------|---------------------------------|
|  |                  |   | A                            | B                            | RHMA-G                       |                                   |                                 |
| Aggregate gradation <sup>a</sup>   | CT 202           | 1 per 750 tons                                      | JMF ± Tolerance <sup>b</sup> | JMF ± Tolerance <sup>b</sup> | JMF ± Tolerance <sup>b</sup> | CT 125                            | 24 hours                        |
| Asphalt binder content (%)   | CT 379 or 382    |   | JMF ±0.45                    | JMF ±0.45                    | JMF ±0.5                     | Loose Mix Behind Paver See CT 125 |                                 |
| Field compaction (% max. theoretical density) <sup>c,d</sup>   | QC Plan          |   | 92 - 96                      | 92 - 96                      | 91 - 96                      | QC Plan                           |                                 |
| Aggregate moisture content at continuous mixing plants and RAP moisture content at continuous mixing plants and batch mixing plants <sup>e</sup> | CT 226 or CT 370 | 2 per day during produc-tion                        | --                           | --                           | --                           | Stock-piles or cold feed belts    | --                              |
| Sand equivalent (min.) <sup>f</sup>  | CT 217           | 1 per 750 tons                                      | 47                           | 42                           | 47                           | CT 125                            | 24 hours                        |
| HMA moisture content (% max.)  | CT 226 or CT 370 | 1 per 2,500 tons but not less than 1 per paving day | 1.0                          | 1.0                          | 1.0                          | Loose Mix Behind Paver See CT 125 | 24 hours                        |
| Stabilometer Value (min.) <sup>f, g</sup><br>No. 4 and 3/8" gradings<br>1/2" and 3/4" gradings   | CT 366           | 1 per 4,000 tons or 2 per 5 bus-iness days,         | 30<br>37                     | 30<br>35                     | --<br>23                     |                                   | 48 hours                        |
| Air voids content (%) <sup>f, h</sup>  | CT 367           | which-ever is more                                  | 4 ± 2                        | 4 ± 2                        | Specifica-tion ± 2           |                                   |                                 |

|  |                  |  |  |  |  |                  |          |
|--|------------------|--|--|--|--|------------------|----------|
| Percent of crushed particles coarse aggregate (% min.)<br>One fractured face<br>Two fractured faces<br>Fine aggregate (% min.)<br>(Passing No. 4 sieve and retained on No. 8 sieve.)<br>One fractured face | CT 205           | As necessary and designated in QCP. At least once per project. | 90   | 25   | --   | CT 125           | 48 hours |
|  |                  |  | 75   | --   | 90   |                  |          |
|  |                  |  | 70   | 20   | 70   |                  |          |
| Los Angeles Rattler (% max.)<br>Loss at 100 rev.<br>Loss at 500 rev.   | CT 211           |  | 12<br>45   | --<br>50   | 12<br>40   | CT 125           |          |
| Fine aggregate angularity (% min.) <sup>i</sup>  | CT 234           |  | 45   | 45   | 45   | CT 125           |          |
| Flat and elongated particle (% max. by weight @ 5:1)   | CT 235           |  | Report only  | Report only  | Report only  | CT 125           |          |
| Voids filled with asphalt (%) <sup>j</sup><br>No. 4 grading<br>3/8" grading<br>1/2" grading<br>3/4" grading  | LP-3             |  | 76.0 – 80.0<br>73.0 – 76.0<br>65.0 – 75.0<br>65.0 – 75.0 | 76.0 – 80.0<br>73.0 – 76.0<br>65.0 – 75.0<br>65.0 – 75.0 | Report only  | LP-3             |          |
| Voids in mineral aggregate (% min.) <sup>j</sup><br>No. 4 grading<br>3/8" grading<br>1/2" grading<br>3/4" grading  | LP-2             |  | 17.0<br>15.0<br>14.0<br>13.0                             | 17.0<br>15.0<br>14.0<br>13.0                             | --<br>--<br>18.0 – 23.0 <sup>k</sup><br>18.0 – 23.0 <sup>k</sup> | LP-2             |          |
| Dust proportion <sup>j</sup><br>No. 4 and 3/8" gradings<br>1/2" and 3/4" gradings  | LP-4             |  | 0.9 – 2.0<br>0.6 – 1.3                                   | 0.9 – 2.0<br>0.6 – 1.3                                   | Report only  | LP-4             |          |
| Smoothness   | Section 39-1.12  | --   | 12-foot straight-edge, must-grind, and PI <sub>0</sub>   | 12-foot straight-edge, must-grind, and PI <sub>0</sub>   | 12-foot straight-edge, must-grind, and PI <sub>0</sub>           | --               |          |
| Asphalt rubber binder viscosity @ 375 °F, centipoises  | Section 39-1.02D | --   | --   | --   | 1,500 – 4,000  | Section 39-1.02D | 24 hours |
| Crumb rubber modifier  | Section 39-1.02D | --   | --   | --   | Section 39-1.02D   | Section 39-1.02D | 48 hours |

Notes:

<sup>a</sup> Determine combined aggregate gradation containing RAP under Laboratory Procedure LP-9.

<sup>b</sup> The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."

<sup>c</sup> Determine field compaction for any of the following conditions:

1. 1/2-inch, 3/8-inch, No. 4 aggregate grading is used and the specified total paved thickness is at least 0.15 foot.
2. 3/4-inch aggregate grading is used and the specified total paved thickness is at least 0.20 foot.

<sup>d</sup> To determine field compaction use:

1. In-place density measurements using the method specified in your QC.
2. California Test 309 to determine maximum theoretical density at the frequency specified in California Test 375, Part 5C.

<sup>e</sup> For adjusting the plant controller at the HMA plant.

<sup>f</sup> Report the average of 3 tests from a single split sample.

<sup>g</sup> Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F  $\pm$  5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."

<sup>h</sup> Determine the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.

<sup>i</sup> The Engineer waives this specification if HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

<sup>j</sup> Report only if the adjustment for asphalt binder content target value is less than or equal to  $\pm$  0.3 percent from OBC.

<sup>k</sup> Voids in mineral aggregate for RHMA-G must be within this range.

Within the specified reporting time, submit written test results including:

1. Sampling location, quantity, and time
2. Testing results
3. Supporting data and calculations

If test results for any quality characteristic are beyond the action limits in the QCP, take corrective actions. Document the corrective actions taken in the inspection records under Section 39-4.03E, "Records of Inspection and Testing."

Stop production, notify the Engineer in writing, take corrective action, and demonstrate compliance with the specifications before resuming production and placement on the State highway if:

1. A lot's composite quality factor,  $QF_C$ , or an individual quality factor,  $QF_{QC_i}$  for  $i = 3, 4$ , or  $5$ , is below 0.90 determined under Section 39-4.03F, "Statistical Evaluation," using quality control data
2. An individual quality factor,  $QF_{QC_i}$  for  $i = 1$  or  $2$ , is below 0.75 using quality control data
3. Quality characteristics for which a quality factor,  $QF_{QC_i}$ , is not determined has 2 consecutive quality control tests not in compliance with the specifications

### **39-4.03D Charts And Records**

Record sampling and testing results for quality control on forms provided in the "Quality Control Manual for Hot Mix Asphalt," or on forms you submit with the QCP. The QCP must also include form posting locations and submittal times.

Submit quality control test results using the Department's statistical evaluation program, HMAPay, available at

[www.dot.ca.gov/hq/construc/hma/index.htm](http://www.dot.ca.gov/hq/construc/hma/index.htm)

### **39-4.03E Records Of Inspection And Testing**

During HMA production, submit in writing a daily:

1. HMA Construction Daily Record of Inspection. Also make this record available at the HMA plant and job site each day.
2. HMA Inspection and Testing Summary. Include in the summary:
  - 2.1. QC worksheet with updated test results from the HMAPay program
  - 2.2. Test forms with the testers' signatures and Quality Control Manager's initials.
  - 2.3. Inspection forms with the inspectors' signatures and Quality Control Manager's initials.
  - 2.4. A list and explanation of deviations from the specifications or regular practices.
  - 2.5. A signed statement by the Quality Control Manager that says:

"It is hereby certified that the information contained in this record is accurate, and that information, tests, or calculations documented herein comply with the specifications of the contract and the

standards set forth in the testing procedures. Exceptions to this certification are documented as part of this record."

Retain for inspection the records generated as part of quality control including inspection, sampling, and testing for at least 3 years after final acceptance.

### **39-4.03F Statistical Evaluation**

#### **General**

Determine a lot's composite quality factor,  $QF_C$ , and the individual quality factors,  $QF_{QC_i}$ . Perform statistical evaluation calculations to determine these quality factors based on quality control test results for:

1. Aggregate gradation
2. Asphalt binder content
3. Percent of maximum theoretical density

The Engineer grants a waiver and you must use 1.0 as the individual quality factor for percent of maximum theoretical density,  $QF_{QC5}$ , for HMA paved in:

1. Areas where the total paved thickness is less than 0.15 foot
2. Areas where the total paved thickness is less than 0.20 foot and a 3/4-inch grading is specified and used
3. Dig outs
4. Leveling courses
5. Areas where, in the opinion of the Engineer, compaction or compaction measurement by conventional methods is impeded

#### **Statistical Evaluation Calculations**

Use the Variability-Unknown / Standard Deviation Method to determine the percentage of a lot not in compliance with the specifications.

Determine the percentage of work not in compliance with the specification limits for each quality characteristic as follows:

1. Calculate the arithmetic mean ( $\bar{X}$ ) of the test values

$$\bar{X} = \frac{\sum X}{n}$$

where:

$x$  = individual test values  
 $n$  = number of test values

2. Calculate the standard deviation

$$s = \sqrt{\frac{n(\sum x^2) - (\sum x)^2}{n(n-1)}}$$

where:

$\sum(x^2)$  = sum of the squares of individual test values  
 $(\sum x)^2$  = sum of the individual test values squared  
 $n$  = number of test values

3. Calculate the upper quality index ( $Q_u$ )

$$Q_u = \frac{USL - \bar{X}}{s}$$

where:

USL = target value plus the production tolerance or upper specification limit

$s$  = standard deviation  
 $\bar{X}$  = arithmetic mean

4. Calculate the lower quality index ( $Q_L$ );

$$Q_L = \frac{\bar{X} - LSL}{s}$$

where:

$LSL$  = target value minus production tolerance or lower specification limit  
 $s$  = standard deviation  
 $\bar{X}$  = arithmetic mean

5. From the table, Upper Quality Index  $Q_U$  or Lower Quality Index  $Q_L$ , of this Section 39-4.03F, "Statistical Evaluation", determine  $P_U$  ;

where:

$P_U$  = the estimated percentage of work outside the USL.  
 $P_U = 0$ , when USL is not specified.

6. From the table, Upper Quality Index  $Q_U$  or Lower Quality Index  $Q_L$ , of this Section 39-4.03F, "Statistical Evaluation," determine  $P_L$ ;

where:

$P_L$  = the estimated percentage of work outside the LSL.  
 $P_L = 0$ , when LSL is not specified.

7. Calculate the total estimated percentage of work outside the USL and LSL, percent defective

$$\text{Percent defective} = P_U + P_L$$

$P_U$  and  $P_L$  are determined from:



| P <sub>U</sub><br>or<br>P <sub>L</sub> | Upper Quality Index Q <sub>U</sub> or Lower Quality Index Q <sub>L</sub> |      |      |      |      |       |       |       |       |       |       |       |      |
|--|--|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|------|
|  | Sample Size (n)  |      |      |      |      |       |       |       |       |       |       |       |      |
|  | 5  | 6    | 7    | 8    | 9    | 10-11 | 12-14 | 15-17 | 18-22 | 23-29 | 30-42 | 43-66 | >66  |
| 0                                      | 1.72   | 1.88 | 1.99 | 2.07 | 2.13 | 2.20  | 2.28  | 2.34  | 2.39  | 2.44  | 2.48  | 2.51  | 2.56 |
| 1                                      | 1.64   | 1.75 | 1.82 | 1.88 | 1.91 | 1.96  | 2.01  | 2.04  | 2.07  | 2.09  | 2.12  | 2.14  | 2.16 |
| 2                                      | 1.58   | 1.66 | 1.72 | 1.75 | 1.78 | 1.81  | 1.84  | 1.87  | 1.89  | 1.91  | 1.93  | 1.94  | 1.95 |
| 3                                      | 1.52   | 1.59 | 1.63 | 1.66 | 1.68 | 1.71  | 1.73  | 1.75  | 1.76  | 1.78  | 1.79  | 1.80  | 1.81 |
| 4                                      | 1.47   | 1.52 | 1.56 | 1.58 | 1.60 | 1.62  | 1.64  | 1.65  | 1.66  | 1.67  | 1.68  | 1.69  | 1.70 |
| 5                                      | 1.42   | 1.47 | 1.49 | 1.51 | 1.52 | 1.54  | 1.55  | 1.56  | 1.57  | 1.58  | 1.59  | 1.59  | 1.60 |
| 6                                      | 1.38   | 1.41 | 1.43 | 1.45 | 1.46 | 1.47  | 1.48  | 1.49  | 1.50  | 1.50  | 1.51  | 1.51  | 1.52 |
| 7                                      | 1.33   | 1.36 | 1.38 | 1.39 | 1.40 | 1.41  | 1.41  | 1.42  | 1.43  | 1.43  | 1.44  | 1.44  | 1.44 |
| 8                                      | 1.29   | 1.31 | 1.33 | 1.33 | 1.34 | 1.35  | 1.35  | 1.36  | 1.36  | 1.37  | 1.37  | 1.37  | 1.38 |
| 9                                      | 1.25   | 1.27 | 1.28 | 1.28 | 1.29 | 1.29  | 1.30  | 1.30  | 1.30  | 1.31  | 1.31  | 1.31  | 1.31 |
| 10                                     | 1.21   | 1.23 | 1.23 | 1.24 | 1.24 | 1.24  | 1.25  | 1.25  | 1.25  | 1.25  | 1.25  | 1.26  | 1.26 |
| 11                                     | 1.18   | 1.18 | 1.19 | 1.19 | 1.19 | 1.19  | 1.20  | 1.20  | 1.20  | 1.20  | 1.20  | 1.20  | 1.20 |
| 12                                     | 1.14   | 1.14 | 1.15 | 1.15 | 1.15 | 1.15  | 1.15  | 1.15  | 1.15  | 1.15  | 1.15  | 1.15  | 1.15 |
| 13                                     | 1.10   | 1.10 | 1.10 | 1.10 | 1.10 | 1.10  | 1.11  | 1.11  | 1.11  | 1.11  | 1.11  | 1.11  | 1.11 |
| 14                                     | 1.07   | 1.07 | 1.07 | 1.06 | 1.06 | 1.06  | 1.06  | 1.06  | 1.06  | 1.06  | 1.06  | 1.06  | 1.06 |
| 15                                     | 1.03   | 1.03 | 1.03 | 1.03 | 1.02 | 1.02  | 1.02  | 1.02  | 1.02  | 1.02  | 1.02  | 1.02  | 1.02 |
| 16                                     | 1.00   | 0.99 | 0.99 | 0.99 | 0.99 | 0.98  | 0.98  | 0.98  | 0.98  | 0.98  | 0.98  | 0.98  | 0.98 |
| 17                                     | 0.97   | 0.96 | 0.95 | 0.95 | 0.95 | 0.95  | 0.94  | 0.94  | 0.94  | 0.94  | 0.94  | 0.94  | 0.94 |
| 18                                     | 0.93   | 0.92 | 0.92 | 0.92 | 0.91 | 0.91  | 0.91  | 0.91  | 0.90  | 0.90  | 0.90  | 0.90  | 0.90 |
| 19                                     | 0.90   | 0.89 | 0.88 | 0.88 | 0.88 | 0.87  | 0.87  | 0.87  | 0.87  | 0.87  | 0.87  | 0.87  | 0.87 |
| 20                                     | 0.87   | 0.86 | 0.85 | 0.85 | 0.84 | 0.84  | 0.84  | 0.83  | 0.83  | 0.83  | 0.83  | 0.83  | 0.83 |
| 21                                     | 0.84   | 0.82 | 0.82 | 0.81 | 0.81 | 0.81  | 0.80  | 0.80  | 0.80  | 0.80  | 0.80  | 0.80  | 0.79 |
| 22                                     | 0.81   | 0.79 | 0.79 | 0.78 | 0.78 | 0.77  | 0.77  | 0.77  | 0.76  | 0.76  | 0.76  | 0.76  | 0.76 |
| 23                                     | 0.77   | 0.76 | 0.75 | 0.75 | 0.74 | 0.74  | 0.74  | 0.73  | 0.73  | 0.73  | 0.73  | 0.73  | 0.73 |
| 24                                     | 0.74   | 0.73 | 0.72 | 0.72 | 0.71 | 0.71  | 0.70  | 0.70  | 0.70  | 0.70  | 0.70  | 0.70  | 0.70 |
| 25                                     | 0.71   | 0.70 | 0.69 | 0.69 | 0.68 | 0.68  | 0.67  | 0.67  | 0.67  | 0.67  | 0.67  | 0.67  | 0.66 |
| 26                                     | 0.68   | 0.67 | 0.67 | 0.65 | 0.65 | 0.65  | 0.64  | 0.64  | 0.64  | 0.64  | 0.64  | 0.64  | 0.63 |
| 27                                     | 0.65   | 0.64 | 0.63 | 0.62 | 0.62 | 0.62  | 0.61  | 0.61  | 0.61  | 0.61  | 0.61  | 0.61  | 0.60 |
| 28                                     | 0.62   | 0.61 | 0.60 | 0.59 | 0.59 | 0.59  | 0.58  | 0.58  | 0.58  | 0.58  | 0.58  | 0.58  | 0.57 |
| 29                                     | 0.59   | 0.58 | 0.57 | 0.57 | 0.56 | 0.56  | 0.55  | 0.55  | 0.55  | 0.55  | 0.55  | 0.55  | 0.54 |
| 30                                     | 0.56   | 0.55 | 0.54 | 0.54 | 0.53 | 0.53  | 0.52  | 0.52  | 0.52  | 0.52  | 0.52  | 0.52  | 0.52 |
| 31                                     | 0.53   | 0.52 | 0.51 | 0.51 | 0.50 | 0.50  | 0.50  | 0.49  | 0.49  | 0.49  | 0.49  | 0.49  | 0.49 |
| 32                                     | 0.50   | 0.49 | 0.48 | 0.48 | 0.48 | 0.47  | 0.47  | 0.47  | 0.46  | 0.46  | 0.46  | 0.46  | 0.46 |
| 33                                     | 0.47   | 0.48 | 0.45 | 0.45 | 0.45 | 0.44  | 0.44  | 0.44  | 0.44  | 0.43  | 0.43  | 0.43  | 0.43 |
| 34                                     | 0.45   | 0.43 | 0.43 | 0.42 | 0.42 | 0.42  | 0.41  | 0.41  | 0.41  | 0.41  | 0.41  | 0.41  | 0.40 |
| 35                                     | 0.42   | 0.40 | 0.40 | 0.39 | 0.39 | 0.39  | 0.38  | 0.38  | 0.38  | 0.38  | 0.38  | 0.38  | 0.38 |
| 36                                     | 0.39   | 0.38 | 0.37 | 0.37 | 0.36 | 0.36  | 0.36  | 0.36  | 0.36  | 0.36  | 0.36  | 0.36  | 0.36 |
| 37                                     | 0.36   | 0.35 | 0.34 | 0.34 | 0.34 | 0.33  | 0.33  | 0.33  | 0.33  | 0.33  | 0.33  | 0.33  | 0.32 |
| 38                                     | 0.33   | 0.32 | 0.32 | 0.31 | 0.31 | 0.31  | 0.30  | 0.30  | 0.30  | 0.30  | 0.30  | 0.30  | 0.30 |
| 39                                     | 0.30   | 0.30 | 0.29 | 0.28 | 0.28 | 0.28  | 0.28  | 0.28  | 0.28  | 0.28  | 0.28  | 0.28  | 0.28 |
| 40                                     | 0.28   | 0.25 | 0.25 | 0.25 | 0.25 | 0.25  | 0.25  | 0.25  | 0.25  | 0.25  | 0.25  | 0.25  | 0.25 |
| 41                                     | 0.25   | 0.23 | 0.23 | 0.23 | 0.23 | 0.23  | 0.23  | 0.23  | 0.23  | 0.23  | 0.23  | 0.23  | 0.23 |
| 42                                     | 0.23   | 0.20 | 0.20 | 0.20 | 0.20 | 0.20  | 0.20  | 0.20  | 0.20  | 0.20  | 0.20  | 0.20  | 0.20 |
| 43                                     | 0.18   | 0.18 | 0.18 | 0.18 | 0.18 | 0.18  | 0.18  | 0.18  | 0.18  | 0.18  | 0.18  | 0.18  | 0.18 |
| 44                                     | 0.16   | 0.15 | 0.15 | 0.15 | 0.15 | 0.15  | 0.15  | 0.15  | 0.15  | 0.15  | 0.15  | 0.15  | 0.15 |
| 45                                     | 0.13   | 0.13 | 0.13 | 0.13 | 0.13 | 0.13  | 0.13  | 0.13  | 0.13  | 0.13  | 0.13  | 0.13  | 0.13 |
| 46                                     | 0.10   | 0.10 | 0.10 | 0.10 | 0.10 | 0.10  | 0.10  | 0.10  | 0.10  | 0.10  | 0.10  | 0.10  | 0.10 |
| 47                                     | 0.08   | 0.08 | 0.08 | 0.08 | 0.08 | 0.08  | 0.08  | 0.08  | 0.08  | 0.08  | 0.08  | 0.08  | 0.08 |
| 48                                     | 0.05   | 0.05 | 0.05 | 0.05 | 0.05 | 0.05  | 0.05  | 0.05  | 0.05  | 0.05  | 0.05  | 0.05  | 0.05 |
| 49                                     | 0.03   | 0.03 | 0.03 | 0.03 | 0.03 | 0.03  | 0.03  | 0.03  | 0.03  | 0.03  | 0.03  | 0.03  | 0.03 |
| 50                                     | 0.00   | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00 |

1. If the value of Q<sub>U</sub> or Q<sub>L</sub> does not correspond to a value in the table, use the next lower value.
2. If Q<sub>U</sub> or Q<sub>L</sub> are negative values, P<sub>U</sub> or P<sub>L</sub> is equal to 100 minus the table value for P<sub>U</sub> or P<sub>L</sub>.

### Quality Factor Determination

Determine individual quality factors,  $QF_{QCi}$ , using percent defective =  $P_U + P_L$  and:

| Quality Factor | Quality Factors                                     |    |    |    |    |       |       |       |       |       |       |       |     |
|----------------|---|----|----|----|----|-------|-------|-------|-------|-------|-------|-------|-----|
|                | Maximum Allowable Percent Defective ( $P_U + P_L$ ) |    |    |    |    |       |       |       |       |       |       |       |     |
|                | Sample Size (n)                                     |    |    |    |    |       |       |       |       |       |       |       |     |
|                | 5   | 6  | 7  | 8  | 9  | 10-11 | 12-14 | 15-17 | 18-22 | 23-29 | 30-42 | 43-66 | >66 |
| 1.05           |   |    |    | 0  | 0  | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0   |
| 1.04           |   |    | 0  | 1  | 3  | 5     | 4     | 4     | 4     | 3     | 3     | 3     | 3   |
| 1.03           |   | 0  | 2  | 4  | 6  | 8     | 7     | 7     | 6     | 5     | 5     | 4     | 4   |
| 1.02           |   | 1  | 3  | 6  | 9  | 11    | 10    | 9     | 8     | 7     | 7     | 6     | 6   |
| 1.01           | 0   | 2  | 5  | 8  | 11 | 13    | 12    | 11    | 10    | 9     | 8     | 8     | 7   |
| 1.00           | 22  | 20 | 18 | 17 | 16 | 15    | 14    | 13    | 12    | 11    | 10    | 9     | 8   |
| 0.99           | 24  | 22 | 20 | 19 | 18 | 17    | 16    | 15    | 14    | 13    | 11    | 10    | 9   |
| 0.98           | 26  | 24 | 22 | 21 | 20 | 19    | 18    | 16    | 15    | 14    | 13    | 12    | 10  |
| 0.97           | 28  | 26 | 24 | 23 | 22 | 21    | 19    | 18    | 17    | 16    | 14    | 13    | 12  |
| 0.96           | 30  | 28 | 26 | 25 | 24 | 22    | 21    | 19    | 18    | 17    | 16    | 14    | 13  |
| 0.95           | 32  | 29 | 28 | 26 | 25 | 24    | 22    | 21    | 20    | 18    | 17    | 16    | 14  |
| 0.94           | 33  | 31 | 29 | 28 | 27 | 25    | 24    | 22    | 21    | 20    | 18    | 17    | 15  |
| 0.93           | 35  | 33 | 31 | 29 | 28 | 27    | 25    | 24    | 22    | 21    | 20    | 18    | 16  |
| 0.92           | 37  | 34 | 32 | 31 | 30 | 28    | 27    | 25    | 24    | 22    | 21    | 19    | 18  |
| 0.91           | 38  | 36 | 34 | 32 | 31 | 30    | 28    | 26    | 25    | 24    | 22    | 21    | 19  |
| 0.90           | 39  | 37 | 35 | 34 | 33 | 31    | 29    | 28    | 26    | 25    | 23    | 22    | 20  |
| 0.89           | 41  | 38 | 37 | 35 | 34 | 32    | 31    | 29    | 28    | 26    | 25    | 23    | 21  |
| 0.88           | 42  | 40 | 38 | 36 | 35 | 34    | 32    | 30    | 29    | 27    | 26    | 24    | 22  |
| 0.87           | 43  | 41 | 39 | 38 | 37 | 35    | 33    | 32    | 30    | 29    | 27    | 25    | 23  |
| 0.86           | 45  | 42 | 41 | 39 | 38 | 36    | 34    | 33    | 31    | 30    | 28    | 26    | 24  |
| 0.85           | 46  | 44 | 42 | 40 | 39 | 38    | 36    | 34    | 33    | 31    | 29    | 28    | 25  |
| 0.84           | 47  | 45 | 43 | 42 | 40 | 39    | 37    | 35    | 34    | 32    | 30    | 29    | 27  |
| 0.83           | 49  | 46 | 44 | 43 | 42 | 40    | 38    | 36    | 35    | 33    | 31    | 30    | 28  |
| 0.82           | 50  | 47 | 46 | 44 | 43 | 41    | 39    | 38    | 36    | 34    | 33    | 31    | 29  |
| 0.81           | 51  | 49 | 47 | 45 | 44 | 42    | 41    | 39    | 37    | 36    | 34    | 32    | 30  |
| 0.80           | 52  | 50 | 48 | 46 | 45 | 44    | 42    | 40    | 38    | 37    | 35    | 33    | 31  |
| 0.79           | 54  | 51 | 49 | 48 | 46 | 45    | 43    | 41    | 39    | 38    | 36    | 34    | 32  |
| 0.78           | 55  | 52 | 50 | 49 | 48 | 46    | 44    | 42    | 41    | 39    | 37    | 35    | 33  |
| 0.77           | 56  | 54 | 52 | 50 | 49 | 47    | 45    | 43    | 42    | 40    | 38    | 36    | 34  |
| 0.76           | 57  | 55 | 53 | 51 | 50 | 48    | 46    | 44    | 43    | 41    | 39    | 37    | 35  |
| 0.75           | 58  | 56 | 54 | 52 | 51 | 49    | 47    | 46    | 44    | 42    | 40    | 38    | 36  |
| Reject         | 60  | 57 | 55 | 53 | 52 | 51    | 48    | 47    | 45    | 43    | 41    | 40    | 37  |
|                | 61  | 58 | 56 | 55 | 53 | 52    | 50    | 48    | 46    | 44    | 43    | 41    | 38  |
|                | 62  | 59 | 57 | 56 | 54 | 53    | 51    | 49    | 47    | 45    | 44    | 42    | 39  |
|                | 63  | 61 | 58 | 57 | 55 | 54    | 52    | 50    | 48    | 47    | 45    | 43    | 40  |
|                | 64  | 62 | 60 | 58 | 57 | 55    | 53    | 51    | 49    | 48    | 46    | 44    | 41  |

Reject Values Greater Than Those Shown Above

Notes:

- To obtain a quality factor when the estimated percent outside specification limits from table, "Upper Quality Index  $Q_U$  or Lower Quality Index  $Q_L$ ," does not correspond to a value in the table, use the next larger value.

Compute the composite of single quality factors,  $QF_C$ , for a lot using:

$$QF_C = \sum_{i=1}^5 w_i QF_{QCi}$$

where:

$QF_C$  = the composite quality factor for the lot rounded to 2 decimal places.  
 $QF_{QCi}$  = the quality factor for the individual quality characteristic.  
 $w$  = the weighting factor listed in the table HMA Acceptance – QC / QA.

$i =$  the quality characteristic index number in the table HMA Acceptance – QC / QA.

### 39-4.04 ENGINEER'S QUALITY ASSURANCE

#### 39-4.04A General

The Engineer assures quality by:

1. Reviewing mix designs and proposed JMF
2. Inspecting procedures
3. Conducting oversight of quality control inspection and records
4. Verification sampling and testing during production and paving

#### 39-4.04B Verification Sampling And Testing

##### General

The Engineer samples:

1. Aggregate to verify gradation
2. HMA to verify asphalt binder content

##### Verification

For aggregate gradation and asphalt binder content, the minimum ratio of verification testing frequency to quality control testing frequency is 1:5. The Engineer performs at least 3 verification tests per lot.

Using the t-test, the Engineer compares quality control tests results for aggregate gradation and asphalt binder content with corresponding verification test results. The Engineer uses the average and standard deviation of up to 20 sequential sublots for the comparison. The Engineer uses production start-up evaluation tests to represent the first subplot. When there are less than 20 sequential sublots, the Engineer uses the maximum number of sequential sublots available. The 21st subplot becomes the 1st subplot ( $n = 1$ ) in the next lot.

The t-value for a group of test data is computed as follows:

$$t = \frac{|\bar{X}_c - \bar{X}_v|}{S_p \sqrt{\frac{1}{n_c} + \frac{1}{n_v}}} \quad \text{and} \quad S_p^2 = \frac{S_c^2(n_c - 1) + S_v^2(n_v - 1)}{n_c + n_v - 2}$$

where:

- $n_c$  = Number of quality control tests (2 minimum, 20 maximum).
- $n_v$  = Number of verification tests (minimum of 1 required).
- $\bar{X}_c$  = Mean of quality control tests.
- $\bar{X}_v$  = Mean of verification tests.
- $S_p$  = Pooled standard deviation (When  $n_v = 1$ ,  $S_p = S_c$ ).
- $S_c$  = Standard deviation of quality control tests.
- $S_v$  = Standard deviation of verification tests (when  $n_v > 1$ ).

The comparison of quality control test results and the verification test results is at a level of significance of  $\alpha = 0.025$ . The Engineer computes t and compares it to the critical t-value,  $t_{crit}$ , from:

**Critical T-Value**

| Degrees of freedom<br>( $n_c+n_v-2$ ) | $t_{crit}$<br>(for $\alpha = 0.025$ ) | Degrees of freedom<br>( $n_c+n_v-2$ ) | $t_{crit}$<br>(for $\alpha = 0.025$ ) |
|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| 1                                     | 24.452                                | 18                                    | 2.445                                 |
| 2                                     | 6.205                                 | 19                                    | 2.433                                 |
| 3                                     | 4.177                                 | 20                                    | 2.423                                 |
| 4                                     | 3.495                                 | 21                                    | 2.414                                 |
| 5                                     | 3.163                                 | 22                                    | 2.405                                 |
| 6                                     | 2.969                                 | 23                                    | 2.398                                 |
| 7                                     | 2.841                                 | 24                                    | 2.391                                 |
| 8                                     | 2.752                                 | 25                                    | 2.385                                 |
| 9                                     | 2.685                                 | 26                                    | 2.379                                 |
| 10                                    | 2.634                                 | 27                                    | 2.373                                 |
| 11                                    | 2.593                                 | 28                                    | 2.368                                 |
| 12                                    | 2.560                                 | 29                                    | 2.364                                 |
| 13                                    | 2.533                                 | 30                                    | 2.360                                 |
| 14                                    | 2.510                                 | 40                                    | 2.329                                 |
| 15                                    | 2.490                                 | 60                                    | 2.299                                 |
| 16                                    | 2.473                                 | 120                                   | 2.270                                 |
| 17                                    | 2.458                                 | $\infty$                              | 2.241                                 |

If the t-value computed is less than or equal to  $t_{crit}$ , quality control test results are verified.

If the t-value computed is greater than  $t_{crit}$  and both  $\bar{X}_v$  and  $\bar{X}_c$  comply with acceptance specifications, the quality control tests are verified. You may continue to produce and place HMA with the following allowable differences:

1.  $\left| \bar{X}_v - \bar{X}_c \right| \leq 1.0$  percent for any grading
2.  $\left| \bar{X}_v - \bar{X}_c \right| \leq 0.1$  percent for asphalt binder content

If the t-value computed is greater than  $t_{crit}$  and the  $\left| \bar{X}_v - \bar{X}_c \right|$  for grading or asphalt binder content are greater than the allowable differences, quality control test results are not verified and:

1. The Engineer notifies you in writing.
2. You and the Engineer must investigate why the difference exist.
3. If the reason for the difference cannot be found and corrected, the Engineer's test results are used for acceptance and pay.

### **39-4.05 ENGINEER'S ACCEPTANCE**

#### **39-4.05A Testing**

The Engineer samples for acceptance testing and tests for:

**HMA Acceptance – QC / QA**

| Index<br>(i) | Quality Characteristic   |                                  |      |      | Weight<br>-ing<br>Factor<br>(w) | Test<br>Method      | HMA Type   |  |  |
|--------------|--|----------------------------------|------|------|---------------------------------|---------------------|--|--|--|
|              |  |                                  |      |      |                                 |                     | A  | B  | RHMA-G   |
|              |  | Aggregate gradation <sup>a</sup> |      |      |                                 | CT 202              | JMF ± Tolerance <sup>c</sup>                             |  |  |
|              | Sieve  | 3/4"                             | 1/2" | 3/8" |                                 |                     |  |  |  |
| 1            | 1/2"   | X <sup>b</sup>                   | --   | --   | 0.05                            |                     |  |  |  |
| 1            | 3/8"   | --                               | X    | --   | 0.05                            |                     |  |  |  |
| 1            | No. 4  | --                               | --   | X    | 0.05                            |                     |  |  |  |
| 2            | No. 8  | X                                | X    | X    | 0.10                            |                     |  |  |  |
| 3            | No. 200  | X                                | X    | X    | 0.15                            |                     |  |  |  |
| 4            | Asphalt binder content (%)   |                                  |      |      | 0.30                            | CT 379 or<br>382    | JMF ± 0.45   | JMF ± 0.45   | JMF ± 0.5  |
| 5            | Field compaction (% max. theoretical density) <sup>d,e</sup>   |                                  |      |      | 0.40                            | CT 375              | 92 – 96  | 92 – 96  | 91 – 96  |
|              | Sand equivalent (min.) <sup>f</sup>  |                                  |      |      |                                 | CT 217              | 47   | 42   | 47   |
|              | Stabilometer value (min.) <sup>f, g</sup><br>No. 4 and 3/8" gradings<br>1/2" and 3/4" gradings   |                                  |      |      |                                 | CT 366              | 30<br>37   | 30<br>35   | --<br>23   |
|              | Air voids content (%) <sup>f, h</sup>  |                                  |      |      |                                 | CT 367              | 4 ± 2  | 4 ± 2  | Specifica-<br>tion ± 2                             |
|              | Percent of crushed particles coarse aggregate (% min.)<br>One fractured face<br>Two fractured faces<br>Fine aggregate (% min.)<br>(Passing No. 4 sieve and retained on No. 8 sieve.)<br>One fractured face |                                  |      |      |                                 | CT 205              | 90<br>75<br><br>70                                       | 25<br>--<br>20   | --<br>90<br><br>70                                 |
|              | HMA moisture content (% max.)  |                                  |      |      |                                 | CT 226 or<br>CT 370 | 1.0  | 1.0  | 1.0  |
|              | Los Angeles Rattler (% max.)<br>Loss at 100 rev.<br>Loss at 500 rev.   |                                  |      |      |                                 | CT 211              | 12<br>45   | --<br>50   | 12<br>40   |
|              | Fine aggregate angularity (% min.) <sup>i</sup>  |                                  |      |      |                                 | CT 234              | 45   | 45   | 45   |
|              | Flat and elongated particle (% max. by weight @ 5:1)   |                                  |      |      |                                 | CT 235              | Report only  | Report only  | Report only  |
|              | Voids in mineral aggregate (% min.) <sup>j</sup><br>No. 4 grading<br>3/8" grading<br>1/2" grading<br>3/4" grading  |                                  |      |      |                                 | LP-2                | 17.0<br>15.0<br>14.0<br>13.0                             | 17.0<br>15.0<br>14.0<br>13.0                             | (Note k)<br>--<br>--<br>18.0 - 23.0<br>18.0 - 23.0 |
|              | Voids filled with asphalt (%) <sup>j</sup><br>No. 4 grading<br>3/8" grading<br>1/2" grading<br>3/4" grading  |                                  |      |      |                                 | LP-3                | 76.0 - 80.0<br>73.0 - 76.0<br>65.0 - 75.0<br>65.0 - 75.0 | 76.0 - 80.0<br>73.0 - 76.0<br>65.0 - 75.0<br>65.0 - 75.0 | Report only  |
|              | Dust proportion <sup>j</sup><br>No. 4 and 3/8" gradings<br>1/2" and 3/4" gradings  |                                  |      |      |                                 | LP-4                | 0.9 - 2.0<br>0.6 - 1.3                                   | 0.9 - 2.0<br>0.6 - 1.3                                   | Report only  |

|  |                       |  |                 |   |   |   |
|--|-----------------------|--|-----------------|---|---|---|
|  | Smoothness            |  | Section 39-1.12 | 12-foot straight-edge, must-grind, and $PI_0$ | 12-foot straight-edge, must-grind, and $PI_0$ | 12-foot straight-edge, must-grind, and $PI_0$ |
|  | Asphalt binder        |  | Various         | Section 92                                    | Section 92                                    | Section 92                                    |
|  | Asphalt rubber binder |  | Various         | --  | --  | Section 92-1.02(C) and Section 39-1.02D       |
|  | Asphalt modifier      |  | Various         | --  | --  | Section 39-1.02D                              |
|  | Crumb rubber modifier |  | Various         | --  | --  | Section 39-1.02D                              |

Notes:

<sup>a</sup> The Engineer determines combined aggregate gradations containing RAP under Laboratory Procedure LP-9.

<sup>b</sup> "X" denotes the sieves the Engineer considers for the specified aggregate gradation.

<sup>c</sup> The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."

<sup>d</sup> The Engineer determines field compaction for any of the following conditions:

1. 1/2-inch, 3/8-inch, or No.4 aggregate grading is used and the specified total paved thickness is at least 0.15 foot.
2. 3/4-inch aggregate grading is used and the specified total paved thickness is at least 0.20 foot.

<sup>e</sup> To determined field compaction, the Engineer uses:

1. California Test 308, Method A, to determine in-place density of each density core.
2. California Test 309 to determine maximum theoretical density at the frequency specified in California Test 375, Part 5C.

<sup>f</sup> The Engineer reports the average of 3 tests from a single split sample.

<sup>g</sup> Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to  $140^{\circ}\text{F} \pm 5^{\circ}\text{F}$  by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at  $140^{\circ}\text{F}$  for a minimum of 2 hours and not more than 3 hours."

<sup>h</sup> The Engineer determines the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.

<sup>i</sup> The Engineer waives this specification if HMA contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

<sup>j</sup> Report only if the adjustment for asphalt binder content target value is less than or equal to  $\pm 0.3$  percent from OBC.

<sup>k</sup> Voids in mineral aggregate for RHMA-G must be within this range.

The Engineer determines the percent of maximum theoretical density from the average density of 3 density cores you take from every 750 tons of production or part thereof divided by the maximum theoretical density.

The Engineer determines the percent of maximum theoretical density from density cores taken from the final layer measured the full depth of the total paved HMA thickness if any of the following applies:

1. If 1/2-inch, 3/8-inch, or No. 4 aggregate grading is used and the specified total paved thickness is at least 0.15 foot and any layer is less than 0.15 foot.
2. If 3/4-inch aggregate grading is used and the specified total paved thickness is at least 0.20 foot and any layer is less than 0.20 foot.

The Engineer calculates  $QF_{QCi}$  for  $i = 1, 2, 3$ , and 4 using quality control data and  $QF_{QCi}$  for  $i = 5$  using quality assurance data.

The Engineer stops production and terminates a lot if:

1. The lot's composite quality factor,  $QF_C$ , or an individual quality factor,  $QF_{QCi}$  for  $i = 3, 4$ , or 5, is below 0.90 determined under Section 39-4.03F, "Statistical Evaluation"
2. An individual quality factor,  $QF_{QCi}$  for  $i = 1$  or 2, is below 0.75

3. Quality characteristics for which a quality factor,  $QF_{QCi}$ , is not determined has 2 consecutive acceptance or quality control tests not in compliance with the specifications

For any single quality characteristic for which a quality factor,  $QF_{QCi}$ , is not determined, except smoothness, if 2 consecutive acceptance test results do not comply with specifications:

1. Stop production.
2. Take corrective action.
3. In the Engineer's presence, take samples and split each sample into 4 parts. Test 1 part for compliance with the specifications and submit 3 parts to the Engineer. The Engineer tests 1 part for compliance with the specifications and reserves and stores 2 parts.
4. Demonstrate compliance with the specifications before resuming production and placement on the State highway.

### 39-4.05B Statistical Evaluation, Determination Of Quality Factors And Acceptance

#### Statistical Evaluation and Determination of Quality Factors

To determine the individual quality factor,  $QF_{QCi}$ , for any quality factor  $i = 1$  through 5 or a lot's composite quality factor,  $QF_C$ , for acceptance and payment adjustment, the Engineer uses the evaluation specifications under Section 39-4.03F, "Statistical Evaluation," and:

1. Verified quality control test results for aggregate gradation
2. Verified quality control test results for asphalt binder content
3. The Engineer's test results for percent of maximum theoretical density

#### Lot Acceptance Based on Quality Factors

The Engineer accepts a lot based on the quality factors determined for aggregate gradation and asphalt binder content,  $QF_{QCi}$  for  $i = 1$  through 4, using the total number of verified quality control test result values and the total percent defective ( $P_U + P_L$ ).

The Engineer accepts a lot based on the quality factor determined for maximum theoretical density,  $QF_{QC5}$ , using the total number of test result values from density cores and the total percent defective ( $P_U + P_L$ ).

The Engineer calculates the quality factor for the lot,  $QF_C$ , which is a composite of weighted individual quality factors,  $QF_{QCi}$ , determined for each quality characteristic in the HMA Acceptance – QC / QA table in Section 39-4.05A, "Testing."

The Engineer accepts a lot based on quality factors if:

1. The current composite quality factor,  $QF_C$ , is 0.90 or greater
2. Each individual quality factor,  $QF_{QCi}$  for  $i = 3, 4$ , and 5, is 0.90 or greater
3. Each individual quality factor,  $QF_{QCi}$  for  $i = 1$  and 2, is 0.75 or greater

No single quality characteristic test may represent more than the smaller of 750 tons or 1 day's production.

#### Payment Adjustment

If a lot is accepted, the Engineer adjusts payment with the following formula:

$$PA = \sum_{i=1}^n HMA CP * w_i * [QF_{QCi} * (HMATT - WHMATT_i) + WHMATT_i] - (HMA CP * HMATT)$$

where:

|                       |   |
|-----------------------|---|
| PA =                  | Payment adjustment rounded to 2 decimal places.   |
| HMA CP =              | HMA contract price.   |
| HMATT =               | HMA total tons represented in the lot.  |
| WHMATT <sub>i</sub> = | Total tons of waived quality characteristic HMA.  |
| $QF_{QCi}$ =          | Running quality factor for the individual quality characteristic.<br>$QF_{QCi}$ for $i = 1$ through 4 must be from verified Contractor's QC results. $QF_{QC5}$ must be determined from the Engineer's results on density cores taken for percent of maximum theoretical density determination. |
| w =                   | Weighting factor listed in the HMA acceptance table.  |

$i$  = Quality characteristic index number in the HMA acceptance table.

If the payment adjustment is a negative value, the Engineer deducts this amount from payment. If the payment adjustment is a positive value, the Engineer adds this amount to payment.

The 21st subplot becomes the 1st subplot ( $n = 1$ ) in the next lot. When the 21st sequential subplot becomes the 1st subplot, the previous 20 sequential subplots become a lot for which the Engineer determines a quality factor. The Engineer uses this quality factor to pay for the HMA in the lot. If the next lot consists of less than 8 sublots, these sublots must be added to the previous lot for quality factor determination using 21 to 27 sublots.

#### **39-4.05C Dispute Resolution**

For a lot, if you or the Engineer dispute any quality factor,  $QF_{QCi}$ , or verification test result, every subplot in that lot must be retested.

Referee tests must be performed under the specifications for acceptance testing.

Any quality factor,  $QF_{QCi}$ , must be determined using the referee tests.

For any quality factor,  $QF_{QCi}$ , for  $i = 1$  through 5, dispute resolution:

1. If the difference between the quality factors for  $QF_{QCi}$  using the referee test result and the disputed test result is less than or equal to 0.01, the original test result is correct.
2. If the difference between the quality factor for  $QF_{QCi}$  using the referee test result and the disputed test result is more than 0.01, the quality factor determined from the referee tests supersedes the previously determined quality factor.

### **39-5 MEASUREMENT AND PAYMENT**

#### **39-5.01 MEASUREMENT**

The contract item for HMA is measured by weight. The weight of each HMA mixture designated in the Engineer's Estimate must be the combined mixture weight.

If tack coat, asphalt binder, and asphaltic emulsion are paid with separate contract items, their contract items are measured under Section 92, "Asphalts," or Section 94, "Asphaltic Emulsions," as the case may be.

If recorded batch weights are printed automatically, the contract item for HMA is measured by using the printed batch weights, provided:

1. Total aggregate and supplemental fine aggregate weight per batch is printed. If supplemental fine aggregate is weighed cumulatively with the aggregate, the total aggregate batch weight must include the supplemental fine aggregate weight.
2. Total asphalt binder weight per batch is printed.
3. Each truckload's zero tolerance weight is printed before weighing the first batch and after weighing the last batch.
4. Time, date, mix number, load number and truck identification is correlated with a load slip.
5. A copy of the recorded batch weights is certified by a licensed weighmaster and submitted to the Engineer.

The contract item for placing HMA dike is measured by the linear foot along the completed length. The contract item for placing HMA in miscellaneous areas is measured as the in-place compacted area in square yards. In addition to the quantities measured on a linear foot or square yard basis, the HMA for dike and miscellaneous areas are measured by weight.

The contract item for geosynthetic pavement interlayer is measured by the square yard for the actual pavement area covered.

#### **39-5.02 PAYMENT**

The contract prices paid per ton for hot mix asphalt as designated in the Engineer's Estimate include full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all the work involved in constructing hot mix asphalt, complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

If HMA is specified to comply with Section 39-4, "Quality Control / Quality Assurance," the Engineer adjusts payment under that section.

Full compensation for the Quality Control Plan and prepaying conference is included in the contract prices paid per ton for hot mix asphalt as designated in the Engineer's Estimate and no additional compensation will be allowed therefor.



Full compensation for performing and submitting mix designs and for Contractor sampling, testing, inspection, testing facilities, and preparation and submittal of results is included in the contract prices paid per ton for HMA as designated in the Engineer's Estimate and no additional compensation will be allowed therefor.

Full compensation for reclaimed asphalt pavement is included in the contract prices paid per ton for HMA as designated in the Engineer's Estimate and no additional compensation will be allowed therefor.

The contract price paid per ton for hot mix asphalt (leveling) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all the work involved in hot mix asphalt (leveling), complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The State pays for HMA dike at the contract price per linear foot for place HMA dike and by the ton for HMA. The contract prices paid per linear foot for place hot mix asphalt dike as designated in the Engineer's Estimate include full compensation for furnishing all labor, tools, equipment, and incidentals, and for doing all the work involved in placing HMA dike, complete in place, including excavation, backfill, and preparation of the area to receive the dike, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The State pays for HMA specified to be a miscellaneous area at the contract price per square yard for place hot mix asphalt (miscellaneous area) and per ton for hot mix asphalt. The contract price paid per square yard for place hot mix asphalt (miscellaneous area) includes full compensation for furnishing all labor, tools, equipment, and incidentals, and for doing all the work involved in placing HMA (miscellaneous area) complete in place, including excavation, backfill, and preparation of the area to receive HMA (miscellaneous area), as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

If the Quality Control / Quality Assurance construction process is specified, HMA placed in dikes and miscellaneous areas is paid for at the contract price per ton for hot mix asphalt under Section 39-4, "Quality Control / Quality Assurance." Section 39-4.05B, "Statistical Evaluation, Determination of Quality Factors and Acceptance," does not apply to HMA placed in dikes and miscellaneous areas.

If there are no contract items for place hot mix asphalt dike and place hot mix asphalt (miscellaneous area) and the work is specified, full compensation for constructing HMA dikes and HMA (miscellaneous areas) including excavation, backfill, and preparation of the area to receive HMA dike or HMA (miscellaneous area) is included in the contract price paid per ton for the hot mix asphalt designated in the Engineer's Estimate and no separate payment will be made therefor.

The contract price paid per square yard for geosynthetic pavement interlayer of the type shown on the verified Bid Item List includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in placing geosynthetic pavement interlayer, complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The contract price paid per ton for paving asphalt (binder, geosynthetic pavement interlayer) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in applying paving asphalt (binder, geosynthetic pavement interlayer), complete in place, including spreading sand to cover exposed binder material, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

Full compensation for small quantities of HMA placed on geosynthetic pavement interlayer to prevent displacement during construction is included in the contract price paid per ton for the HMA being paved over the interlayer and no separate payment will be made therefor.

The contract price paid per ton for tack coat includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in applying tack coat, complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The Engineer does not adjust payment for increases or decreases in the quantities for tack coat, regardless of the reason for the increase or decrease. Section 4-1.03B, "Increased or Decreased Quantities," does not apply to the items for tack coat.

Full compensation for performing smoothness testing, submitting written and electronic copies of tests, and performing corrective work including applying fog seal coat is included in the contract price paid per ton for the HMA designated in the Engineer's Estimate and no separate payment will be made therefor.

Full compensation for spreading sand on RHMA-G, RHMA-O, and RHMA-O-HB surfaces and for sweeping and removing excess sand is included in the contract price paid per ton for rubberized hot mix asphalt as designated in the Engineer's Estimate and no separate payment will be made therefor.

If the dispute resolution ITP determines the Engineer's test results are correct, the Engineer deducts the ITP's testing costs from payments. If the ITP determines your test results are correct, the State pays the ITP's testing costs. If, in the Engineer's opinion, work completion is delayed because of incorrect Engineer test results, the Department makes payment and time adjustments under Section 8-1.09, "Delays."



#### **40-1.02F Concrete Field Qualification**

Submit field qualification data and test reports including:

1. Mixing date
2. Mixing equipment and procedures used
3. Batch volume in cubic yards
4. Type and source of ingredients used
5. Penetration of the concrete
6. Air content of the plastic concrete
7. Age and strength at time of concrete beam testing

Field qualification test reports must be certified with a signature by an official in responsible charge of the laboratory performing the tests.

#### **40-1.02G Frequency Measuring Device (Tachometer)**

Submit calibration documentation and operational guidelines for frequency measuring devices for concrete consolidation vibrators.

#### **40-1.02H Manufacturer's Recommendations and Instructions**

If used and at least 15 days before delivery to the job site, submit manufacturer's recommendations and instructions for storage and installation of:

1. Threaded tie bar splice couplers
2. Chemical adhesive (drill and bond)
3. Silicone liquid sealant
4. Asphalt rubber liquid sealant
5. Preformed compression seals
6. Joint filler material

#### **40-1.02I Mix Proportions**

At least 15 days before starting testing for mix proportions, submit a copy of the AASHTO accreditation for your laboratory determining the mix proportions. At least 30 days before starting field qualification, submit the proposed concrete mix proportions, the corresponding mix identifications, and laboratory test reports including the modulus of rupture for each trial mixture at 10, 21, 28, and 42 days.

#### **40-1.02J Preformed Compression Seal**

Submit the manufacturer's data sheet used to develop the recommended preformed compression seal based on the joint dimensions.

#### **40-1.02K Concrete Pavement Early Age Crack Mitigation System**

At least 24 hours before each paving shift, submit:

1. Early age stress and strength predictions
2. Scheduled sawing and curing activities
3. Contingency plan if volunteer cracking occurs

At least 24 hours before paving, meet with the Engineer to review the submittals for the early age crack mitigation system.

During paving, update the system with current weather data obtained from a portable weather station. Before paving concrete pavement with these updates, submit new stress and strength predictions and curing and sawing activity schedules.

#### **40-1.02L Profilograms**

Submit profilograms within 5 business days of initial profiling and within 2 business days of profiling corrected sections.

Submit 1 electronic copy of profile information in ".erd" format or other ProVAL compatible format to the Engineer and to:

Smoothness@dot.ca.gov

Submit the original of final profilograms before the Engineer accepts the contract.  
Submitted profilograms become the Department's property.

#### **40-1.02M Protecting Concrete Pavement During Cold Weather**

Submit a plan for protecting concrete pavement during the initial 72 hours after paving when the forecasted minimum ambient temperature is below 40 degrees F.

#### **40-1.02N Quality Control Charts**

Submit updated quality control charts each paving day.

#### **40-1.02O Quality Control Plan**

At least 30 days before the start of field qualification, submit a concrete pavement quality control plan (QCP).

### **40-1.03 QUALITY CONTROL AND ASSURANCE**

#### **40-1.03A Contractor Quality Control Plan**

Establish, implement, and maintain a QCP for concrete pavement. The QCP must describe the organization and procedures you use to:

1. Control the production process
2. Determine if changes to the production process are needed
3. Implement changes

The QCP must address the elements affecting concrete pavement quality including:

1. Mix proportions
2. Aggregate gradation
3. Materials quality
4. Stockpile management
5. Line and grade control
6. Proportioning
7. Mixing and transportation
8. Placing and consolidation
9. Contraction and construction joints
10. Dowel bar placement, alignment, and anchorage
11. Tie bar placement
12. Modulus of rupture
13. Finishing and curing
14. Surface smoothness
15. Joint sealant and compression seal installation

The QCP must include details of corrective action to be taken if any process is out of control. As a minimum, a process is out of control if any of the following occurs:

1. For fine and coarse aggregate gradation, 2 consecutive running averages of 4 tests are outside the specification limits
2. For individual penetration or air content measurements:
  - 2.1. One point falls outside the suspension limit line
  - 2.2. Two points in a row fall outside the action limit line

Stop production and take corrective action for out of control processes or the Engineer rejects subsequent material.

#### 40-1.03B Quality Control Testing

Select random locations and perform sampling and testing in compliance with:

| Quality Control Testing                       |               |                  |
|---|---------------|------------------|
| Test  | Frequency     | Test Method      |
| Cleanness value                               | 2 per day     | CT 227           |
| Sand equivalent                               | 2 per day     | CT 217           |
| Aggregate gradation                           | 2 per day     | CT 202           |
| Air content (freeze thaw) <sup>a</sup>        | 1 per hour    | CT 504           |
| Air content (non-freeze thaw)                 | 1 per 4 hours | CT 504           |
| Density                                       | 1 per 4 hours | CT 518           |
| Penetration                                   | 1 per 4 hours | CT 533           |
| Calibration of moisture meter <sup>b, c</sup> | 1 per day     | CT 223 or CT 226 |

Notes:

<sup>a</sup> If air entrainment is specified, make at least 1 air content measurement per hour. If air entrainment is not specified, make at least 1 air content measurement per 4 hours.

<sup>b</sup> Make at least 1 measurement of moisture content per week to check the calibration of an electronically actuated moisture meter.

<sup>c</sup> Random location sampling and testing is not applicable.

If air entrainment is specified, the testing laboratory and tester must be qualified under the Department's Independent Assurance Manual. The manual is available from the Transportation Laboratory.

#### 40-1.03C Control Charts

Maintain control charts to identify potential problems and assignable causes. Post a copy of each control chart at a location determined by the Engineer.

Individual measurement control charts must use the target values in the mix proportions as indicators of central tendency.

Develop linear control charts for:

1. Cleanness value
2. Sand equivalent
3. Fine and coarse aggregate gradation
4. Air content
5. Penetration

Control charts must include:

1. Contract number
2. Mix proportions
3. Test number
4. Each test parameter
5. Action and suspension limits
6. Specification limits
7. Quality control test results

For fine and coarse aggregate gradation control charts, record the running average of the previous 4 consecutive gradation tests for each sieve and superimpose the specification limits.

For penetration and air content control charts, record the individual measurements and superimpose the following action and suspension limits:

| Penetration and Air Content Action and Suspension Limits |                         |                  |
|--|-------------------------|------------------|
| Control Parameter  | Individual Measurements |                  |
|  | Action Limit            | Suspension Limit |
| Penetration, CT 533                                      | 1 inch                  | 1-1/2 inch       |
| Air content, CT 504                                      | ±1.0 percent            | ±1.5 percent     |

#### **40-1.03D Contractor's Laboratory**

Use a laboratory that complies with ASTM C 1077 to determine the mix proportions for concrete pavement. The laboratory must have a current AASHTO accreditation for:

1. AASHTO T 97 or ASTM C 78
2. ASTM C 192/C 192M

#### **40-1.03E Joint Sealant and Compression Seal Installation Training**

Before installing joint sealant or compression seals, arrange for a representative from the joint sealant or compression seal manufacturer to provide training on the cleaning and preparation of the joint and installing the sealant or seal. Until your personnel and the Department's personnel have been trained, do not install joint sealant or compression seals.

#### **40-1.03F Frequency Measuring Device (Tachometer)**

Before each day's concrete pavement placement and at intervals not to exceed 4 hours of production, test and record vibration frequency for concrete consolidation vibrators.

#### **40-1.03G Early Age Concrete Pavement Crack Mitigation System**

Develop and implement a system for predicting concrete pavement stresses and strength during the initial 72 hours after paving. The system must include:

1. Subscribing to a weather service to obtain forecasts for wind speed, ambient temperatures, humidity, and cloud cover
2. Portable weather station with anemometer, temperature and humidity sensors, located at the paving site
3. Early age concrete pavement stress and strength prediction computer program
4. Analyzing, monitoring, updating, and reporting the system's predictions

#### **40-1.03H Curing Compound**

Sample curing compound from shipping containers at the manufacturer's source of supply. Split the samples.

#### **40-1.03I Concrete Pavement Smoothness**

Within 10 days after paving, measure the Profile Index ( $PI_0$ ) of the concrete pavement surface using a zero (null) blanking band under California Test 526.

For the following concrete pavement areas, the Engineer does not require a profilograph and you must test and correct high points determined by a 12-foot straightedge placed parallel with and perpendicular to the centerline:

1. Horizontal curves with a centerline radius of curvature less than 1,000 feet including concrete pavement within the superelevation transitions of those curves.
2. Exit ramp termini, truck weigh stations, and weigh-in-motion areas
3. Where steep grades and superelevation rates greater than 6 percent are present on:
  - 3.1. Ramps
  - 3.2. Connectors
4. Turn lanes and areas around manholes or drainage transitions
5. Acceleration and deceleration lanes for at-grade intersections
6. Shoulders and miscellaneous gore areas

Use a California Profilograph to determine the concrete pavement profile. If the profilograph uses a mechanical recorder, use an electronic scanner to reduce the profilogram.

The profilograph operator must be qualified under the Department's Independent Assurance Manual. The manual is available from the Department's Materials Engineering and Testing Services Web site.

#### **40-1.03J Profilograph Test Procedure**

Notify the Engineer at least 2 business days before performing profilograph testing. Each day before performing profilograph testing, notify the Engineer of the start location. Perform profilograph testing in the Engineer's presence.

Before starting profilograph testing, remove foreign objects from the concrete pavement surface.

Before starting profilograph testing, calibrate the profilograph in the Engineer's presence. If the Engineer chooses not to be present during profilograph testing, you may perform the testing with the Engineer's written approval. Note the Engineer's absence on the profilogram.

Determine  $PI_0$  values for the final concrete pavement surface of each 0.1-mile section of a traffic lane. Take 2 profiles within each traffic lane, 3 feet from and parallel with the edge of each lane. Each section's  $PI_0$  is the average of the  $PI_0$  values for the measurements within that traffic lane. A section that is less than 0.01 mile and is the result of an interruption to continuous concrete pavement surface must comply with the  $PI_0$  specifications for a full section. Adjust the  $PI_0$  for a partial section to reflect a full section.

Use stationing to locate vertical deviations greater than 0.3 inches. The profilogram stationing must be the same as the project stationing. Note 0.1-mile segments on the profilogram.

Label the profilogram with:

1. Contract number
2. County and route number
3. Stationing
4. Operator's name
5. Test date
6. Test number
7. Traffic direction
8. Traffic lane (numbered from left to right in direction of travel)
9. Test wheel path (left or right in direction of travel)
10. Test direction
11. Paving direction

#### **40-1.03K Smoothness Corrective Action**

Correct concrete pavement not complying with the Engineer's acceptance specifications for smoothness by grinding under Section 42-2, "Grinding."

Do not grind before:

1. Ten days after concrete pavement placement
2. The concrete has developed a modulus of rupture of at least 550 psi

Grind the entire lane width. When completed, the lane width must be uniform in texture and appearance. Square the corrected area's start and end normal to the paved surface's centerline.

Retest sections where corrections were made.

#### **40-1.03L Acceptance Criteria**

##### **General**

Concrete pavement is accepted based on the Department's testing for the concrete pavement quality characteristics shown in the following table:

| <b>Concrete Pavement Acceptance Testing</b> |  |             |
|---|--|-------------|
| Quality Characteristic                      | Quantity   | Test        |
| 28-day modulus of rupture                   | 1,000 cubic yards                                | CT 523      |
| Thickness                                   | 1,200 square yards for primary area measurements | CT 531      |
| Dowel bar placement                         | 700 square yards                                 | Measurement |
| Tie bar placement                           | 4,000 square yards                               | Measurement |
| Coefficient of friction                     | One day's paving                                 | CT 342      |
| Air content (freeze-thaw) <sup>a</sup>      | One day's paving                                 | CT 504      |

Note:

<sup>a</sup> Air content tests must be performed under California Test 504 if air entrainment is specified.

Pavement smoothness may be accepted based on the Department's testing. A single test represents no more than 0.1 mile.

Acceptance of modulus of rupture, thickness, dowel bar and tie bar placement, coefficient of friction, smoothness, and air content, does not constitute final concrete pavement acceptance.

### **Modulus of Rupture**

The Engineer accepts concrete pavement for modulus of rupture on a lot basis. The minimum modulus of rupture for each lot is 570 psi at 28 days.

For each lot of concrete for concrete pavement:

1. Quantity must not exceed 1,000 cubic yards.
2. Department determines the modulus of rupture of test beams aged 10 days and 28 days.
3. Department calculates the modulus of rupture by averaging the individual test results of 2 beams aged for 28 days.

The Department provides molds and machines for modulus of rupture acceptance testing. Provide material and labor the Engineer may require.

### **Concrete Pavement Smoothness**

If the Department tests for smoothness, the tests are performed under Section 40-1.03I, "Concrete Pavement Smoothness."

The Engineer accepts concrete pavement for smoothness in compliance with the following:

1. For tangents and horizontal curves having a centerline radius of curvature 2,000 feet or more, the  $PI_0$  must be at most 2-1/2 inches per 0.1-mile section.
2. For horizontal curves having a centerline radius of curvature from 1,000 to 2,000 feet including concrete pavement within the superelevation transitions of those curves, the  $PI_0$  must be at most 5 inches per 0.1-mile section.
3. If using a profilograph to measure smoothness, the surface must not have individual high points greater than 0.3 inch.
4. If using a straightedge to measure smoothness, the surface must be within 0.02 foot of the straightedge's lower edge.

Profile index specifications apply to existing pavement within 50 feet of the transverse joint separating new concrete pavement and the existing pavement.

If the Department's profilograph test results do not match yours, the Engineer may order you to recalibrate your profilograph equipment and perform a retest. If your test results are inaccurate due to operator error, the Engineer may disqualify your profilograph operator. If the Engineer determines your test results are inaccurate, the Engineer does not make adjustments to payment or contract time for recalibrating, retesting, and delays.

### **Concrete Pavement Thickness**

The Engineer accepts concrete pavement for thickness based on coring in the primary area, which is the area placed in 1 day for each thickness. Concrete pavement thickness must not be deficient by more than 0.05 foot.

After corrective grinding has been completed, core concrete pavement in the primary area under Section 40-3.16, "Obtaining Drilled Cores," at locations determined by the Engineer and in the Engineer's presence. The core specimen diameter must be 4 inches. To identify the limits of concrete pavement deficient in thickness by more than 0.05 foot, you may divide primary areas into secondary areas. Specifications that may affect concrete pavement thickness such as allowable tolerances for subgrade construction do not change the thickness specified for concrete pavement.

In each primary area, the Engineer measures concrete pavement thickness every 1,200 square yards and any remaining area. The Engineer measures cores under California Test 531 to the nearest 0.01 foot. Core at least 1 foot from existing, contiguous, and parallel concrete pavement not constructed as part of this contract.

You may request the Engineer make additional thickness measurements and use them to determine the average thickness variation. The Engineer determines the locations with random sampling methods.

If each thickness measurement in a primary area is less than 0.05 foot deficient, the Engineer calculates the average thickness deficiency in that primary area. The Engineer uses 0.02 foot for a thickness difference more than 0.02 foot over the specified thickness.

For each thickness measurement in a primary area deficient by more than 0.05 foot, the Engineer determines a secondary area where the thickness deficiency is more than 0.05 foot. The Engineer determines this secondary area



by measuring the thickness of each concrete pavement slab adjacent to the measurement found to be more than 0.05 foot deficient. The Engineer continues to measure the thickness until an area that is bound by slabs with thickness deficient by 0.05 foot or less is determined.

Slabs without bar reinforcement are defined as the areas bound by longitudinal and transverse joints and concrete pavement edges. Slabs with bar reinforcement are defined as the areas bound by longitudinal joints and concrete pavement edges and 15-foot lengths. Secondary area thickness measurements in a slab determine that entire slab's thickness.

The Engineer measures the remaining primary area thickness after removing the secondary areas from consideration for determining the average thickness deficiency.

The Engineer determines the slabs to remove and replace.

### Required Use of Air-Entraining Admixtures

If air-entraining admixtures are specified, the Engineer may choose to accept concrete pavement for air content based on your air content quality control tests. The Engineer decides to use your air content quality control tests based on a  $t$ -test that determines the difference in the means of your test and the Engineer's verification tests. The Engineer calculates the  $t$ -value of the test data as follows:

$$t = \frac{|\bar{X}_c - \bar{X}_v|}{S_p \sqrt{\frac{1}{n_c} + \frac{1}{n_v}}} \quad \text{and} \quad S_p^2 = \frac{S_c^2(n_c - 1) + S_v^2(n_v - 1)}{n_c + n_v - 2}$$

where:

- $n_c$  = Number of your quality control tests (minimum of 6 required)
- $n_v$  = Number of verification tests (minimum of 2 required)
- $\bar{X}_c$  = Mean of your quality control tests
- $\bar{X}_v$  = Mean of the verification tests
- $S_p$  = Pooled standard deviation  
(When  $n_v = 1$ ,  $S_p = S_c$ )
- $S_c$  = Standard deviation of your quality control tests
- $S_v$  = Standard deviation of the verification tests (when  $n_v > 1$ )

The Engineer compares your quality control test results with the Department's verification test results at a level of significance of  $\alpha = 0.01$ . The Engineer compares the  $t$ -value to  $t_{crit}$ , determined from:

| $t_{crit}$                                |                                      |
|---|--------------------------------------|
| degrees of freedom<br>( $n_c + n_v - 2$ ) | $t_{crit}$<br>(for $\alpha = 0.01$ ) |
| 1   | 63.657                               |
| 2   | 9.925                                |
| 3   | 5.841                                |
| 4   | 4.604                                |
| 5   | 4.032                                |
| 6   | 3.707                                |
| 7   | 3.499                                |
| 8   | 3.355                                |
| 9   | 3.250                                |
| 10  | 3.169                                |

If the  $t$ -value calculated is less than or equal to  $t_{crit}$ , your quality control test results are verified. If the  $t$ -value calculated is greater than  $t_{crit}$ , quality control test results are not verified.

If your quality control test results are not verified, core at least 3 specimens from concrete pavement under Section 40-3.16, "Obtaining Drilled Cores." The Engineer selects the core locations. Your approved third party independent testing laboratory must test these specimens for air content under ASTM C 457. The Engineer

compares these test results with your quality control test results using the *t*-test method. If your quality control test results are verified based on this comparison, the Engineer uses the quality control test results for acceptance of concrete pavement for air content. If your quality control test results are not verified based on this comparison, the Engineer uses the air content of core specimens determined under ASTM C 457 for acceptance.

### **Dowel Bar and Tie Bar Placement**

Dowel bar alignment must comply with section 40-3.06. Tie bar alignment must comply with Section 40-3.05. Except for CRCP, core specimens for:

1. Dowel bar placement
2. Tie bar placement
3. Concrete consolidation

Obtain cores under Section 40-3.16, "Obtaining Drilled Cores." The Engineer determines the core locations. Each core must have a nominal diameter of 4 inches. Core each day's paving within 2 business days in compliance with:

1. One test for every 700 square yards of doweled concrete pavement or remaining fraction of that area. Each dowel bar test consists of 2 cores, 1 on each dowel bar end to expose both ends and allow measurement.
2. One test for every 4,000 square yards of concrete pavement with tie bars or remaining fraction of that area. Each tie bar test consists of 2 cores, 1 on each tie bar end to expose both ends and allow measurement.

If the tests indicate dowel or tie bars are not placed within the specified tolerances or if there are air voids around the dowel or tie bars, core additional specimens to determine the limits of unacceptable work.

The Engineer determines the slabs to remove and replace.

If the Engineer approves your request, slabs may remain in place with an adjustment in payment for:

1. Dowel bars with centers from  $\pm 2$  inches to  $\pm 3$  inches from the saw cut of a transverse contraction joint or with deficient concrete consolidation around the dowel bars
2. Tie bars placed outside their specified placement and position or with deficient concrete consolidation around the tie bars

### **Bar Reinforcing Steel**

The Engineer accepts concrete pavement for bar reinforcing steel based on inspection before concrete placement.

### **Curing Compound**

Curing compound sampled from shipping containers from the manufacturer's supply source or from the job site must match the test results for viscosity, nonvolatile content, and pigment content within the specified tolerances listed in the precision and bias statements for the test methods.

## **40-2 MATERIALS**

### **40-2.01 CONCRETE**

#### **40-2.01A General**

Concrete must comply with Section 90, "Portland Cement Concrete."

#### **40-2.01B Aggregate**

The specifications for reduction in Operating Range and Contract Compliance for cleanliness value and sand equivalent specified under Section 90-2.02A, "Coarse Aggregate," and Section 90-2.02B, "Fine Aggregate," do not apply to concrete pavement.

Combined aggregate gradings must comply with Section 90-3, "Aggregate Gradings," and the difference between the percent passing the 3/8-inch sieve and the percent passing the No. 8 sieve must not be less than 16 percent of the total aggregate.

#### **40-2.01C Cementitious Material**

Concrete for concrete pavement must contain from 505 pounds to 675 pounds cementitious material per cubic yard. Determine the minimum cementitious materials content. Use your value for minimum cementitious material content for *MC* in equation 1 and equation 2 of section 90-1.02B(3).

#### **40-2.01D Mix Proportions**

Your laboratory determining mix proportions must determine the minimum cementitious materials content or the maximum water to cementitious materials ratio and:

1. You must make trial mixtures no more than 24 months before field qualification.
2. Modulus of rupture used to determine the minimum cementitious materials content or maximum water to cementitious materials ratio must be 570 psi at 28 days age and 650 psi at 42 days age.
3. Your laboratory must determine an increase in the cementitious materials content or a decrease in the water to cementitious materials ratio from the trial mixtures to ensure concrete pavement complies with the specifications.

If changing an aggregate supply source or the mix proportions, produce a trial batch and field-qualify the new concrete. The Engineer does not adjust contract time for performing sampling, testing, and qualifying new mix proportions or changing an aggregate supply source.

#### **40-2.01E Field Qualification**

Proposed mix proportions must be field qualified before you place concrete pavement. Use an American Concrete Institute (ACI) certified "Concrete Laboratory Technician, Grade I" to perform field qualification tests and calculations.

The Engineer accepts field qualification if five beams made and tested under California Test 523 comply with the following:

1. At a minimum, beams are tested at 10, 21, and 28 days of age
2. At your choice of age not later than 28 days, no single beam's modulus of rupture is less than 550 psi and the average modulus of rupture is at least 570 psi

#### **40-2.02 TIE BARS**

Tie bars must be deformed bars.

If the project is not shown to be in high desert or any mountain climate region, tie bars must be one of the following:

1. Epoxy-coated bar reinforcement. Bars must comply with Section 52-1.02B, "Epoxy-coated Reinforcement" except bars must comply with either ASTM A 706/A 706M; ASTM A 996/A 996M; or ASTM A 615/A 615M, Grade 40 or 60.
2. Stainless-steel bars. Bars must be descaled, pickled, polished, and solid stainless-steel bars under ASTM A 955/A 955M, Grade 60, UNS Designation S31603 or S31803.
3. Low carbon, chromium-steel bars complying with ASTM A 1035/A 1035M.

If the project is shown to be in high desert or any mountain climate region, tie bars must be one of the following:

1. Epoxy-coated bar reinforcement. Bars must comply with "Epoxy-coated Prefabricated Reinforcement" in the special provisions except bars must comply with either ASTM A 706/A 706M; ASTM A 996/A 996M; or ASTM A 615/A 615M, Grade 40 or 60.
2. Stainless-steel bars. Bars must be descaled, pickled, polished, and solid stainless-steel bars under ASTM A 955/A 955M, Grade 60, UNS Designation S31603 or S31803.

Fabricate, sample, and handle epoxy-coated deformed tie bars at the job site under ASTM D 3963/D 3963M and Section 52-1.02B, "Epoxy-coated Reinforcement."

Do not bend tie bars.

#### **40-2.03 DOWEL BARS**

##### **40-2.03A General**

Dowel bars must be plain bars. Fabricate, sample, and handle epoxy-coated dowel bars under ASTM D 3963/D 3963M and section 52-1.02B, "Epoxy-coated Reinforcement," except each sample must be 18 inches long.

If the project is not shown to be in high desert or any mountain climate region, dowel bars must be one of the following:

1. Epoxy-coated bars. Bars must comply with ASTM A 615/A 615M, Grade 40 or 60. Epoxy coating must comply with either (1) Section 52-1.02B, "Epoxy-coated Reinforcement" or (2) "Epoxy-coated Prefabricated Reinforcement" in the special provisions.
2. Stainless-steel bars. Bars must be descaled, pickled, polished, and solid stainless-steel bars under ASTM A 955/A 955M, Grade 60, UNS Designation S31603 or S31803.
3. Low carbon, chromium-steel bars under ASTM A 1035/A 1035M.

If the project is shown to be in high desert or any mountain climate region, dowel bars must be one of the following:

1. Epoxy-coated bars. Bars must comply with ASTM A 615/A 615M, Grade 40 or 60. Epoxy coating must comply with "Epoxy-coated Prefabricated Reinforcement" in the special provisions.
2. Stainless-steel bars. Bars must be descaled, pickled, polished, and solid stainless-steel bars under ASTM A 955/A 955M, Grade 60, UNS Designation S31603 or S31803.

##### **40-2.03B Dowel Bar Lubricant**

Dowel bar lubricant must be either (1) petroleum paraffin based or (2) curing compound no. 3. Paraffin-based lubricant must be either Dayton Superior DSC BB-Coat, Valvoline Tectyl 506, or an approved equal. Petroleum paraffin based lubricant must be factory-applied.

#### **40-2.04 CURING COMPOUND**

Curing compound must be curing compound (1) or (2) with white pigment under Section 90-7.01B, "Curing Compound Method."

Reflectance must be at least 60 percent when tested under ASTM E 1347.

#### **40-2.05 CHEMICAL ADHESIVE (DRILL AND BOND)**

Chemical adhesive for drilling and bonding dowels and tie bars must be prequalified. A list of prequalified chemical adhesives is available on the Department's Materials Engineering and Testing Services website. The prequalified list indicates the appropriate chemical adhesive system for the concrete temperature and installation conditions.

Each chemical adhesive system must clearly and permanently show the following:

1. Manufacturer's name
2. Model number of the system
3. Manufacture date
4. Batch number
5. Expiration date
6. Current International Conference of Building Officials Evaluation Report number
7. Directions for use
8. Warnings or precautions required by state and federal laws and regulations

#### **40-2.06 DOWEL AND TIE BAR BASKETS**

For dowel and tie bar baskets, wire must comply with ASTM A 82/A 82M and be welded under ASTM A 185/A 185M, Section 7.4. The minimum wire-size no. is W10. Use either U-frame or A-frame shaped assemblies.

If the project is not shown to be in high desert or any mountain climate region. Baskets may be epoxy-coated, and the epoxy coating must comply with either (1) Section 52-1.02B, "Epoxy-coated Reinforcement" or (2) "Epoxy-coated Prefabricated Reinforcement" in the special provisions.

If the project is shown to be in high desert or any mountain climate region, wire for dowel bar and tie bar baskets must be one of the following:

1. Epoxy-coated wire under "Epoxy-coated Prefabricated Reinforcement" in the special provisions
2. Stainless-steel wire. Wire must be descaled, pickled, and polished solid stainless-steel. Wire must comply with (1) the chemical requirements in ASTM A 276/A 276M, UNS Designation S31603 or S31803 and (2) the tension requirements in ASTM A 1022/ A 1022M.

Handle epoxy-coated tie bar and dowel bar baskets under ASTM D 3963/D 3963M and either (1) Section 52-1.02B, "Epoxy-coated Reinforcement" or (2) "Epoxy-coated Prefabricated Reinforcement" in the special provisions.

Fasteners must be driven fasteners under ASTM F 1667. Fasteners on lean concrete base or HMA must have a minimum shank diameter of 3/16 inch and a minimum shank length of 2-1/2 inches. For asphalt treated permeable base or cement treated permeable base, the shank diameter must be at least 3/16 inch and the shank length must be at least 5 inches.

Fasteners, clips, and washers must have a minimum 0.2-mil thick zinc coating applied either by electroplating or galvanizing.

#### **40-2.07 BACKER RODS**

Backer rods must be Type 1 under ASTM D 5249. Backer rod diameter must be at least 25 percent greater than the sawcut joint width. Backer rod material must be expanded, crosslinked, closed-cell polyethylene foam. No bond or adverse reaction may occur between the backer rod and sealant.

#### **40-2.08 JOINT FILLER MATERIAL**

Joint filler for isolation joints must be preformed expansion joint filler for concrete (bituminous type) under ASTM D 994.

#### **40-2.09 HYDRAULIC CEMENT GROUT (NON-SHRINK)**

Hydraulic cement grout (non-shrink) must comply with ASTM C 1107/ C 1107M. Use clean, uniform, rounded aggregate filler to extend the grout. Aggregate filler must not exceed 60 percent of the grout mass or the maximum recommended by the manufacturer, whichever is less. Aggregate filler moisture content must not exceed 0.5 percent. Aggregate filler must comply with:

| <b>Aggregate Filler Grading</b> |                           |
|---------------------------------|---------------------------|
| <b>Sieve Size</b>               | <b>Percentage Passing</b> |
| 1/2-inch                        | 100                       |
| 3/8-inch                        | 85 - 100                  |
| No. 4                           | 10 - 30                   |
| No. 8                           | 0 - 10                    |
| No. 16                          | 0 - 5                     |

#### **40-2.10 BAR REINFORCEMENT**

Bar reinforcement must be deformed bars.

If the project is not shown to be in high desert or any mountain climate region, bar reinforcement must comply with section 52.

If the project is shown to be in high desert or any mountain climate regions, bar reinforcement must be one of the following:

1. Epoxy-coated bar reinforcement under section 52-2.03B except bars must comply with either ASTM A 706/A 706M; ASTM A 996/A 996M; or ASTM A 615/A 615M, Grade 40 or 60. Bars must be handled under ASTM D 3963/D 3963M and section 52-2.02C.
2. Low carbon, chromium steel bar complying with ASTM A 1035/A 1035M

#### **40-2.11 JOINT SEALANT**

##### **40-2.11A General**

Do not use hot-pour sealant that will melt the backer rod.

#### **40-2.11B Silicone Joint Sealant**

Silicone joint sealant must be prequalified. A list of prequalified silicone joint sealant available on the Department's Materials Engineering and Testing Services Web site at:

[http://www.dot.ca.gov/hq/esc/approved\\_products\\_list/](http://www.dot.ca.gov/hq/esc/approved_products_list/)

#### **40-2.11C Asphalt Rubber Joint Sealant**

Asphalt rubber joint sealant must:

1. Be a mixture of paving asphalt and ground rubber containing not less than 22 percent ground rubber by weight. One hundred percent of ground rubber must pass a No. 8 sieve. Ground rubber must be vulcanized or a combination of vulcanized and devulcanized materials.
2. Comply with ASTM D 6690, Type II except:
  - 2.1. The cone penetration requirement must not exceed 120 at 77 °F, 5 ounces, 5 seconds.
  - 2.2. The resilience requirement must be a minimum 50 percent recovery when tested at 77 °F.
3. Have a Ring and Ball softening point of 135 °F minimum when tested under AASHTO T 53.
4. Be capable of being melted and applied to cracks and joints at temperatures below 400 °F.
5. Not be applied when the concrete pavement surface temperature is below 50 °F.

#### **40-2.11D Preformed Compression Joint Seals**

Preformed compression joint seals must comply with ASTM D 2628. Lubricant adhesive used with the seals must comply with ASTM D 2835. Preformed compression joint seals must have 5 or 6 cells, except seals for Type A2 and Type B joints may have 4 cells. Install preformed compression joint seals in compliance with the manufacturer's recommendations. Show evidence that the seals are compressed from 30 to 50 percent for the joint width at the time of installation.

#### **40-2.12 WATER**

Water for core drilling may be obtained from a potable water source, or submit proof that it does not contain:

1. More than 1,000 parts per million of chlorides as Cl
2. More than 1,300 parts per million of sulfates as SO<sub>4</sub>
3. Impurities that cause pavement discoloration or surface etching

### **40-3 CONSTRUCTION**

#### **40-3.01 WATER SUPPLY**

Before placing concrete pavement, develop enough water supply for the work.

#### **40-3.02 SUBGRADE PREPARATION**

Immediately before placing concrete, the subgrade to receive concrete pavement must be:

1. In compliance with the specified compaction and elevation tolerances
2. Free of loose and extraneous material
3. Uniformly moist, but free of standing or flowing water
4. Excavated for thickened parts of concrete pavement end anchors with no disturbed compaction outside the end anchor dimensions

If cement treated permeable base is specified, cover the base surface with asphaltic emulsion before placing concrete pavement. Apply the asphaltic emulsion uniformly at a rate of 0.1 gallons per square yard. Asphaltic emulsion must comply with anionic slow-setting type, SS1h grade in Section 94, "Asphaltic Emulsions." Repair damaged asphaltic emulsion before placing concrete pavement.

#### **40-3.03 PROPORTIONING**

Proportion aggregate and bulk cementitious materials under Section 90-5, "Proportioning."

#### **40-3.04 PLACING CONCRETE**

##### **40-3.04A General**

Place concrete pavement with stationary side forms or slip-form paving equipment.

Place consecutive concrete loads within 30 minutes of each other. Construct a transverse construction joint when concrete placement is interrupted by more than 30 minutes. The transverse construction joint must coincide with the next contraction joint location, or you must remove fresh concrete pavement to the preceding transverse joint location.

Place concrete pavement in full slab widths separated by construction joints or monolithically in multiples of full lane widths with a longitudinal contraction joint at each traffic lane line.

Do not retemper concrete.

If the concrete pavement surface width is constructed as specified, you may construct concrete pavement sides on a batter not flatter than 6:1 (vertical:horizontal).

##### **40-3.04B Concrete Pavement Widening**

If concrete pavement is placed adjacent to existing pavement not constructed as part of the contract, grind the existing concrete pavement lane or shoulder adjacent to the new concrete pavement. Perform the grinding before new concrete pavement is placed. The new concrete pavement must match the elevation of the existing concrete pavement after grinding. Grind existing concrete pavement under Section 42-2, "Grinding," except profile index must comply with the pavement smoothness specifications in Section 40-1.03, "Quality Control and Assurance."

Use paving equipment with padded crawler tracks or rubber-tired wheels on the existing concrete pavement with enough offset to avoid breaking or cracking the existing concrete pavement's edge.

##### **40-3.04C Concrete Pavement Transition Panel**

For concrete pavement placed in a transition panel, texture the surface with a drag strip of burlap, a broom, or a spring steel tine device that produces scoring in the finished surface. The scoring must be either parallel with or transverse to the centerline. For the method you choose, texture at the time that produces the coarsest texture.

##### **40-3.04D Stationary Side Form Construction**

Stationary side forms must be straight and without defects including warps, bends, and indentations. Side forms must be metal except at end closures and transverse construction joints where other materials may be used.

You may build up side forms by attaching a section to the top or bottom. If attached to the top of metal forms, the attached section must be metal.

The side form's base width must be at least 80 percent of the specified concrete pavement thickness.

Side forms including interlocking connections with adjoining forms must be rigid enough to prevent springing from subgrading and paving equipment and concrete pressure.

Construct subgrade to final grade before placing side forms. Side forms must bear fully on the foundation throughout their length and base width. Place side forms to the specified grade and alignment of the finished concrete pavement's edge. Support side forms during concrete placing, compacting, and finishing.

After subgrade work is complete and immediately before placing concrete, true side forms and set to line and grade for a distance that avoids delays due to form adjustment.

Clean and oil side forms before each use.

Side forms must remain in place for at least 1 day after placing concrete and until the concrete pavement edge no longer requires protection from the forms.

Spread, screed, shape, and consolidate concrete with 1 or more machines. The machine must uniformly distribute and consolidate the concrete. The machines must operate to place the concrete pavement to the specified cross section with minimal hand work.

Consolidate the concrete without segregation. If vibrators are used:

1. The vibration rate must be at least 3,500 cycles per minute for surface vibrators and 5,000 cycles per minute for internal vibrators
2. Amplitude of vibration must cause perceptible concrete surface movement at least 1 foot from the vibrating element
3. Use a calibrated tachometer for measuring frequency of vibration
4. Vibrators must not rest on side forms or new concrete pavement
5. Power to vibrators must automatically cease when forward or backward motion of the paving machine is stopped

Use high-frequency internal vibrators within 15 minutes of depositing concrete on the subgrade to uniformly consolidate the concrete across the paving width including adjacent to forms. Do not use vibrators to shift the mass of concrete.

#### **40-3.04E Slip-Form Construction**

If slip-form construction is used, spread, screed, shape, and consolidate concrete to the specified cross section with slip-form machines and minimal hand work. Slip-form paving machines must be equipped with traveling side forms and must not segregate the concrete.

Do not deviate from the specified concrete pavement alignment by more than 0.1 foot.

Slip-form paving machines must use high frequency internal vibrators to consolidate concrete. You may mount vibrators with their axes parallel or normal to the concrete pavement alignment. If mounted with axes parallel to the concrete pavement alignment, space vibrators no more than 2.5 feet measured center to center. If mounted with axes normal to the concrete pavement alignment, space the vibrators with a maximum 0.5-foot lateral clearance between individual vibrators.

Each vibrator must have a vibration rate from 5,000 cycles per minute to 8,000 cycles per minute. The amplitude of vibration must cause perceptible concrete surface movement at least 1 foot from the vibrating element. Use a calibrated tachometer to measure frequency of vibration.

#### **40-3.05 TIE BAR PLACEMENT**

Place tie bars in compliance with the tolerances shown in the following table:

Tie Bar Tolerance

| Dimension                     | Tolerance   |
|-------------------------------|---|
| Horizontal and vertical skew  | 10 degrees maximum  |
| Longitudinal translation      | ±2 inch maximum   |
| Horizontal offset (embedment) | ±2 inch maximum   |
| Vertical depth                | 1. Not less than 1/2 inch below the saw cut depth of joints<br>2. When measured at any point along the bar, not less than 2 inches clear of the pavement's surface and bottom |

Install tie bars at longitudinal joints by 1 of the following methods:

1. Drill concrete and bond tie bars with chemical adhesive in compliance with the manufacturer's instructions. Clean and dry drilled holes before placing chemical adhesive and tie bars. After inserting tie bars into chemical adhesive, support the bars to prevent movement during curing. If the Engineer rejects a tie bar installation, cut the tie bar flush with the joint face and coat the exposed end of the tie bar with chemical adhesive under Section 40-2, "Materials." Offset new holes 3 inches horizontally from the rejected hole's center.
2. Insert tie bars into plastic slip-formed concrete before finishing. Inserted tie bars must have full contact between the bar and the concrete. If tie bars are inserted through the plastic concrete surface, eliminate evidence of the insertion by reworking the concrete over the tie bars.
3. Use threaded tie bar splice couplers fabricated from deformed bar reinforcement free of external welding or machining.
4. Use tie bar baskets. Anchor baskets at least 200 feet in advance of concrete pavement placement activity. If you request a waiver, describe the construction limitations or restricted access preventing the advanced anchoring. After the baskets are anchored and before paving, demonstrate the tie bars do not move from their specified depth and alignment during paving. Use fasteners to anchor tie bar baskets.

If tie bars are not placed correctly, stop paving activities until you demonstrate to the Engineer correction of the cause.

#### **40-3.06 DOWEL BAR PLACEMENT**

Center dowel bars within 2 inches in the longitudinal direction on transverse contraction joints or construction joints.



If using curing compound as lubricant, apply the curing compound to dowels in 2 separate applications. Lubricate each dowel bar entirely with bond breaker before placement. The last application must be applied not more than 8 hours before placing the dowel bars. Apply each curing compound application at a rate of 1 gallon per 150 square feet.

If dowel bars are placed by mechanical insertion, eliminate evidence of the insertion by reworking the concrete over the dowel bars. If drilling and bonding dowel bars at construction joints, use a grout retention ring.

If using dowel bar baskets, anchor them with fasteners.

Use at least 10 fasteners for basket sections greater than 12 feet and less than or equal to 16 feet. Baskets must be anchored at least 200 feet in advance of the concrete placement activity unless the Engineer approves your waiver request. If requesting a waiver, describe the construction limitations or restricted access preventing the advanced anchoring. After the baskets are anchored and before the concrete is placed, cut and remove temporary spacer wires and demonstrate the dowel bars do not move from their specified depth and alignment during concrete placement.

Place dowel bars in compliance with:

| <b>Dowel Bar Tolerances</b> |   |
|-----------------------------|---|
| Dimension                   | Tolerance   |
| Horizontal offset           | ±1 inch   |
| Longitudinal translation    | ±2 inches   |
| Horizontal skew             | 3/8 inch, max   |
| Vertical skew               | 3/8 inch, max   |
| Vertical depth              | <p>The minimum distance below the concrete pavement surface must be:</p> $DB = d/3 + 1/2 \text{ inch}$ <p>where:<br/> DB = vertical distance in inches, measured from concrete pavement surface to any point along the top of dowel bar<br/> d = concrete pavement thickness in inches</p> <p>The maximum distance below the depth shown must be 5/8 inch..</p> |

If dowel bars are not placed correctly, stop paving activities until you demonstrate to the Engineer correction of the cause.

Remove and replace the concrete pavement 3 feet on either side of a joint with a rejected dowel bar.

#### **40-3.07 BAR REINFORCEMENT**

Place bar reinforcement under Section 52, "Reinforcement." Bar reinforcement must be more than 1/2 inch below the saw cut depth at concrete pavement joints.

#### **40-3.08 JOINTS**

##### **40-3.08A General**

Concrete pavement joints consist of:

1. Longitudinal and transverse construction joints
2. Longitudinal and transverse contraction joints
3. Isolation joints

Construction joints must be normal to the concrete pavement surface.

Until contract acceptance and except for joint filler material, keep joints free of foreign material including soil, gravel, concrete, or asphalt mix.

Volunteer cracks are cracks not coincident with constructed joints.

Repair concrete pavement damaged during joint construction under Section 40-3.17B, "Repair of Spalls, Raveling, and Tearing."

Do not bend tie bars or reinforcement in existing concrete pavement joints.

#### **40-3.08B Construction Joints**

Construction joints form where fresh concrete is placed against hardened concrete, existing pavements, or structures.

Before placing concrete at construction joints, apply a curing compound under Section 90-7.01B, "Curing Compound Method," to the vertical surface of existing or hardened concrete and allow it to dry.

Use a metal or wooden bulkhead to form transverse construction joints. If dowel bars are specified, the bulkhead must allow dowel bar installation.

#### **40-3.08C Contraction Joints**

In multilane monolithic concrete pavement, use the sawing method to construct longitudinal contraction joints. Construct transverse contraction joints by the sawing method.

Construct transverse contraction joints within 1 foot of their specified spacing. If a slab length of less than 5 feet would be formed, adjust the transverse contraction joint spacing.

Construct transverse contraction joints across the full concrete pavement width regardless of the number or types of longitudinal joints crossed. In areas of converging and diverging pavements, space transverse contraction joints so their alignment is continuous across the full width where converging and diverging pavements are contiguous. Longitudinal contraction joints must be parallel with the concrete pavement centerline. Transverse and longitudinal contraction joints must not deviate by more than 0.1 foot from either side of a 12-foot straight line, except for longitudinal joints parallel to a curving centerline.

#### **40-3.08D Isolation Joints**

Construct isolation joints by saw cutting a minimum 1/8-inch width to full concrete pavement depth at the existing concrete pavement's edge and removing the concrete to expose a flat vertical surface. Before placing concrete, secure joint filler material that prevents new concrete from adhering to the existing concrete face.

Dispose of concrete saw cutting residue under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way."

#### **40-3.08E Sawing Method**

The sawing method is cutting a groove in the concrete pavement with a power driven concrete saw. Grooves for longitudinal and transverse contraction joints must be the minimum width possible for the type of saw used. If necessary, the top of the joint must be sawn wider to provide space for joint sealant. Immediately wash slurry from the joint with water under 100 psi maximum pressure.

Saw longitudinal and transverse contraction joints before volunteer cracking occurs and after the concrete is hard enough to saw without spalling, raveling, or tearing.

To keep foreign material out of grooves before joint sealant or compression seal installation, you may use joint filler in sawed contraction joints. Joint filler must not react adversely with the concrete or cause concrete pavement damage. After sawing and washing a joint, install joint filler material that keeps moisture in the adjacent concrete during the 72 hours after paving. If you install joint filler material, the specifications for spraying the sawed joint with additional curing compound under Section 40-3.13, "Curing," do not apply. If using absorptive filler material, moisten the filler immediately before or after installation.

### **40-3.09 JOINT SEALANT AND COMPRESSION SEAL INSTALLATION**

#### **40-3.09A General**

At least 7 days after concrete pavement placement and not more than 4 hours before installing joint sealant or compression seal materials, use dry sand blasting and other methods to clean the joint walls of objectionable material such as soil, asphalt, curing compound, paint, and rust. The maximum sand blasting nozzle diameter must be 1/4 inch. The minimum pressure must be 90 psi. Sand blast each side of the joint at least once, in at least 2 separate passes. Hold the nozzle at an angle to the joint from 1 to 2 inches from the concrete pavement. Using a vacuum, collect sand, dust, and loose material at least 2 inches on each side of the joint. Remove surface moisture and dampness at the joints with compressed air that may be moderately hot.

Before you install joint sealant or compression seal, the joint wall must be free of moisture, residue, or film.

If grinding or grooving over or adjacent to sealed joints, remove joint sealant or compression seal materials and dispose of them under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way." After grinding or grooving, replace the joint sealant or compression seal materials.

#### **40-3.09B Liquid Sealant**

Do not install liquid sealant in construction joints.

Install backer rods when the concrete pavement temperature is above the air dew point and when the air temperature is at least 40 °F.

Install liquid sealant immediately after installing the backer rod. Install sealant using a mechanical device with a nozzle shaped to introduce the sealant from inside the joint. Extrude sealant evenly and with continuous contact with the joint walls. Recess the sealant surface after placement. Remove excess sealant from the concrete pavement surface.

Do not allow traffic over sealed joints until the sealant is set.

#### **40-3.09C Preformed Compression Seal**

Install preformed compression seal in construction or isolation joints when specified in the special provisions.

Install longitudinal seals before transverse seals. Longitudinal seals must be continuous except splicing is allowed at intersections with transverse seals. Transverse seals must be continuous for the entire transverse length of concrete pavement except splices are allowed for widenings and staged construction. With a sharp instrument, cut across the longitudinal seal at the intersection with transverse construction joints. If the longitudinal seal does not relax enough to properly install the transverse seal, trim the longitudinal seal to form a tight seal between the 2 joints.

If splicing is authorized, splicing must comply with the manufacturer's written instructions.

Use a machine specifically designed for preformed compression seal installation. The machine must install the seal:

1. To the specified depth
2. To make continuous contact with the joint walls
3. Without cutting, nicking, or twisting the seal
4. With less than 4 percent stretch

Lay a length of preformed compression seal material cut to the exact length of the pavement joint to be sealed. The Engineer measures this length. After you install the length of preformed compression joint sealant, the Engineer measures the excess amount of material at the joint end. The Engineer divides the excess amount length by the original measured length to determine the percentage of stretch.

#### **40-3.10 SHOULDER RUMBLE STRIP**

If specified, construct shoulder rumble strips by rolling or grinding indentations in new concrete pavement.

Select the method and equipment for constructing ground-in indentations.

Do not construct shoulder rumble strips on structures or approach slabs.

Construct rumble strips within 2 inches of the specified alignment. Roller or grinding equipment must be equipped with a sighting device enabling the operator to maintain the rumble strip alignment.

Indentations must not vary from the specified dimensions by more than 1/16 inch in depth or more than 10 percent in length and width.

The Engineer orders grinding or removal and replacement of noncompliant rumble strips to bring them within specified tolerances. Ground surface areas must be neat and uniform in appearance.

The grinding equipment must be equipped with a vacuum attachment to remove residue.

Dispose of removed material under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way."

#### **40-3.11 PRELIMINARY FINISHING**

##### **40-3.11A General**

Preliminary finishing must produce a smooth and true-to-grade finish. After preliminary finishing, mark each day's concrete pavement with a stamp. The stamp must be approved by the Engineer before paving starts. The stamp must be approximately 1' x 2' in size. The stamp must form a uniform mark from 1/8 to 1/4 inch deep. Locate the mark 20 feet ± 5 feet from the transverse construction joint formed at each day's start of paving and 1 foot ± 0.25 foot from the concrete pavement's outside edge. The stamp mark must show the month, day, and year of placement and the station of the transverse construction joint. Orient the stamp mark so it can be read from the concrete pavement's outside edge.

Do not apply more water to the concrete pavement surface than can evaporate before float finishing and texturing are completed.

#### **40-3.11B Stationary Side Form Finishing**

If stationary side form construction is used, give the concrete a preliminary finish by the machine float method or the hand method.

If using the machine float method:

1. Use self-propelled machine floats.
2. Determine the number of machine floats required to perform the work at a rate equal to the concrete delivery rate. When the time from concrete placement to machine float finishing exceeds 30 minutes, stop concrete delivery. When machine floats are in proper position, you may resume concrete delivery and paving.
3. Machine floats must run on side forms or adjacent concrete pavement lanes. If running on adjacent concrete pavement, protect the adjacent concrete pavement surface under Section 40-3.15, "Protecting Concrete Pavement."
4. Floats must be hardwood, steel, or steel-shod wood. Floats must be equipped with devices that adjust the underside to a true flat surface.

If using the hand method, finish concrete smooth and true to grade with manually operated floats or powered finishing machines.

#### **40-3.11C Slip-Form Finishing**

If slip-form construction is used, the slip-form paver must give the concrete pavement a preliminary finish. You may supplement the slip-form paver with machine floats.

Before the concrete hardens, correct concrete pavement edge slump in excess of 0.02 foot exclusive of edge rounding.

#### **40-3.12 FINAL FINISHING**

After completing preliminary finishing, round the edges of the initial paving widths to a 0.04-foot radius. Round transverse and longitudinal construction joints to a 0.02-foot radius.

Before curing, texture the pavement. Perform initial texturing with a burlap drag or broom device that produces striations parallel to the centerline. Perform final texturing with a steel-tined device that produces grooves parallel with the centerline.

Construct longitudinal grooves with a self-propelled machine designed specifically for grooving and texturing concrete pavement. The machine must have tracks to maintain constant speed, provide traction, and maintain accurate tracking along the pavement surface. The machine must have a single row of rectangular spring steel tines. The tines must be from 3/32 to 1/8 inch wide, on 3/4-inch centers, and must have enough length, thickness, and resilience to form grooves approximately 3/16 inch wide. The machine must have horizontal and vertical controls. The machine must apply constant down pressure on the pavement surface during texturing. The machines must not cause raveling.

Construct grooves over the entire pavement width in a single pass except do not construct grooves 3 inches from the concrete pavement edges and longitudinal joints. Final texture must be uniform and smooth. Use a guide to properly align the grooves. Grooves must be parallel and aligned to the pavement edge across the pavement width. Grooves must be from 1/8 to 3/16 inch deep after concrete has hardened.

For irregular areas and areas inaccessible to the grooving machine, you may hand-construct grooves in compliance with the hand method under Section 40-3.11B, "Stationary Side Form Finishing." Hand-constructed grooves must comply with the specifications for machine-constructed grooves.

Initial and final texturing must produce a coefficient of friction of at least 0.30 when tested under California Test 342. Notify the Engineer when the concrete pavement is scheduled to be opened to traffic to allow at least 25 days for the Department to schedule for test for coefficient of friction. Notify the Engineer when the pavement is ready for testing which is the latter of:

1. Seven days after concrete placement
2. When the concrete pavement has attained a modulus of rupture of 550 psi

The Department tests for coefficient of friction within 7 days of receiving notification that the pavement is ready for testing.

Do not open the concrete pavement to traffic unless the coefficient of friction is at least 0.30.

Correct concrete pavement not complying with the Engineer's acceptance criteria for coefficient of friction by grooving or grinding under Section 42, "Groove and Grind Pavement."

Do not grind before:

1. Ten days after concrete pavement placement
2. Concrete has developed a modulus of rupture of at least 550 psi

Before opening to traffic, allow at least 25 days for the Department to retest sections for coefficient of friction after corrections are made.

#### **40-3.13 CURING**

Cure the concrete pavement's exposed area with waterproof membrane or curing compound (1) or (2) under Section 90-7.01, "Methods of Curing." When side forms are removed within 72 hours of the start of curing, also cure the concrete pavement edges.

If curing compound is used, apply it with mechanical sprayers. Reapply curing compound to sawcuts and disturbed areas.

#### **40-3.14 EARLY USE OF CONCRETE PAVEMENT**

If requesting early use of concrete pavement:

1. Furnish molds and machines for modulus of rupture testing
2. Sample concrete
3. Fabricate beam specimens
4. Test for modulus of rupture under California Test 523

When you request early use, concrete pavement must have a modulus of rupture of at least 350 psi. Protect concrete pavement under Section 40-3.15, "Protecting Concrete Pavement."

#### **40-3.15 PROTECTING CONCRETE PAVEMENT**

Protect concrete pavement under Section 90-8, "Protecting Concrete."

Maintain the concrete pavement temperature at not less than 40 °F for the initial 72 hours.

Protect the concrete pavement surface from activities that cause damage and reduce texture and coefficient of friction. Do not allow soil, gravel, petroleum products, concrete, or asphalt mixes on the concrete pavement surface.

Construct crossings for traffic convenience. If the Engineer approves your request, you may use rapid strength concrete for crossings. Do not open crossings until the Department determines by California Test 523 the concrete pavement's modulus of rupture is at least 550 psi.

Do not open concrete pavement to traffic or use equipment on the concrete pavement for 10 days after paving nor before the concrete has attained a modulus of rupture of 550 psi except:

1. If the equipment is for sawing contraction joints
2. If the Engineer approves your request, one side of paving equipment's tracks may be on the concrete pavement after a modulus of rupture of 350 psi has been attained, provided:
  - 2.1. Unit pressure exerted on the concrete pavement by the paver does not exceed 20 psi
  - 2.2. You change the paving equipment tracks to prevent damage or the paving equipment tracks travel on protective material such as planks
  - 2.3. No part of the track is closer than 1 foot from the concrete pavement's edge

If concrete pavement damage including visible cracking occurs, stop operating paving equipment on the concrete pavement and repair the damage.

#### **40-3.16 OBTAINING DRILLED CORES**

Drill concrete pavement cores under ASTM C 42/ C 42M. Core drilling equipment must use diamond impregnated bits.

Clean, dry, and fill core holes with hydraulic cement grout (non-shrink) or pavement concrete. Coat the core hole walls with epoxy under the specifications for epoxy adhesive for bonding new concrete to old concrete in Section 95, "Epoxy." The backfill must match the adjacent concrete pavement surface elevation and texture.

Do not allow residue from core drilling to fall on traffic, flow across shoulders or lanes occupied by traffic, or flow into drainage facilities including gutters.

## **40-3.17 REPAIR, REMOVAL, AND REPLACEMENT**

### **40-3.17A General**

Working cracks are full-depth cracks essentially parallel to a planned contraction joint beneath which a contraction crack has not formed. If the Engineer orders, take 4-inch nominal diameter cores on designated cracks under Section 40-3.16, "Obtaining Drilled Cores."

### **40-3.17B Repair of Spalls, Raveling, and Tearing**

Before concrete pavement is open to traffic, repair spalls, raveling, and tearing in sawed joints. Make repairs in compliance with the following:

1. Saw a rectangular area with a diamond-impregnated blade at least 2 inches deep.
2. Remove unsound and damaged concrete between the saw cut and the joint and to the saw cut's depth. Do not use a pneumatic hammer heavier than 15 pounds. Do not damage concrete pavement to remain in place.
3. Dispose of removed concrete pavement under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way."
4. Clean the repair area's exposed surfaces with high pressure abrasive water blasting. Further clean and dry the exposed surfaces with compressed air free of moisture and oil.
5. Apply epoxy as specified for epoxy resin adhesive for bonding new concrete to old concrete under Section 95, "Epoxy." Apply the epoxy with a stiff bristle brush.
6. Apply a portland cement concrete or mortar patch immediately following the epoxy application. Install an insert to prevent bonding of the sides of planned joints.

Repair spalls if they are:

1. Deeper than 0.05 foot
2. Wider than 0.04 foot
3. Longer than 0.3 foot

### **40-3.17C Route and Seal Working Cracks**

Treat working cracks within 0.5 foot of either side of a planned contraction joint in compliance with the following:

1. Route and seal the crack with epoxy resin in compliance with the following:
  - 1.1. Use a powered rotary router mounted on wheels, with a vertical shaft and a routing spindle that casters as it moves along the crack
  - 1.2. Form a reservoir 3/4 inch deep by 3/8 inch wide in the crack
  - 1.3. Use equipment that does not cause raveling or spalling
  - 1.4. Place liquid sealant
2. Treat the contraction joint adjacent to the working crack in compliance with the following:
  - 2.1. Use epoxy resin under ASTM C 881/C 881M, Type IV, Grade 2 for Type B joints and secondary saw cuts for Type A1 and Type A2 joints
  - 2.2. Pressure inject epoxy resin under ASTM C 881/C881M, Type IV, Grade 1 for narrow saw cuts including initial saw cuts for Type A1 and Type A2 joints

If a working crack intersects a contraction joint, route and seal the working crack and seal the contraction joint as specified for installing liquid sealant under Section 40-3.09, "Joint Seal and Joint Sealant Installation."

### **40-3.17D Removal and Replacement of Slabs**

As specified, remove and replace slabs or partial slabs for:

1. Insufficient thickness
2. Dowel bar misalignment
3. Working cracks more than 0.5 foot from a planned contraction joint

## 40-4 MEASUREMENT AND PAYMENT

### 40-4.01 MEASUREMENT

Concrete pavement is measured by the cubic yard. The Engineer calculates the pay quantity volume based on the dimensions shown on the plans and as ordered.

The contract items for sealing joints as designated in the Verified Bid Item List are measured by the linear foot. Sealing joints are measured from field measurements for each type of sealed joint.

The contract item for shoulder rumble strips is measured by the station along each shoulder on which the rumble strips are constructed without deductions for gaps between indentations.

### 40-4.02 PAYMENT

The contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the concrete pavement, complete in place including bar reinforcement, tie bars, dowel bars, anchors, fasteners, tack coat, and providing the facility for and attending the prepaving conference, as shown on the plans and as specified in these specifications and the special provisions, and as directed by the Engineer.

The Engineer adjusts payment for each primary area deficient in average thickness in compliance with the following:

| <b>Pay Adjustments for Deficient Thickness</b> |                                     |
|--|-------------------------------------|
| Average Thickness<br>Deficiency (foot)         | Deficiency Adjustment<br>(\$/sq yd) |
| 0.01   | 0.90                                |
| 0.02   | 2.30                                |
| 0.03   | 4.10                                |
| 0.04   | 6.40                                |
| 0.05   | 9.11                                |

If the average thickness deficiency is less than 0.01 foot, the Engineer does not adjust payment for thickness deficiency. If the average thickness deficiency is more than 0.01 foot, the Engineer rounds to the nearest 0.01 foot and uses the adjustment table.

Full compensation for core drilling and backfilling the cores ordered by the Engineer for measuring concrete pavement thickness and determining full-depth cracks is included in the contract price paid per cubic yard for concrete pavement as designated in the Engineer's Estimate and no additional compensation will be allowed therefor. The Department does not pay for additional concrete pavement thickness measurements requested by the Contractor.

The Department does not pay for the portion of concrete that penetrates treated permeable base.

Full compensation for the quality control plan is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for furnishing and applying asphaltic emulsion on cement treated permeable base is included in the contract price paid per cubic yard for concrete pavement as designated in the Engineer's Estimate and no separate payment will be made therefor.

Full compensation for repairing joints is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for furnishing, calibrating, and operating profilograph equipment for Profile Index, for submitting profilograms, and for performing corrective work is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for grooving and grinding for final finishing is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for removing and replacing joint material for grooving and grinding is included in the contract price per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for removing and replacing slabs is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for drilling holes and bonding tie bars with chemical adhesive is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no additional compensation will be allowed therefor.

Full compensation for repairing damage caused by operating paving equipment on new concrete pavement is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

The material and work necessary for the construction of crossings for public convenience, and their subsequent removal and disposal, will be paid for at the contract prices for the items of work involved and if there are no contract items for the work involved, payment for concrete pavement crossings will be made by extra work as specified in Section 4-1.03D, "Extra Work."

The Department will reduce payments to the Contractor by \$56.12 per square yard for concrete pavement slabs allowed to remain in place represented by cores indicating dowel bars placed with their centers from  $\pm 2$  inches to  $\pm 3$  inches from the saw cut of a transverse contraction joint

The Engineer will calculate the reduced payment using the slab dimensions adjacent to and inclusive of the joints with misplaced dowel bars. This reduced payment is in addition to other specified payment reductions.

The Department will reduce payments to the Contractor by \$59.56 per square yard for concrete pavement allowed to remain in place represented by cores indicating either of the following:

1. Tie bars placed outside their specified placement and position tolerances
2. Bar reinforcement placed outside their specified placement and position tolerances

The Engineer will calculate the reduced payment using the slab dimensions adjacent to and inclusive of the joints with misplaced tie bars. This reduced payment is in addition to other specified payment reductions.

Full compensation for core drilling for checking dowel or tie bar alignment and backfilling the cores is included in the contract price paid per cubic yard for concrete pavement as designated in the Engineer's Estimate and no additional compensation will be allowed therefor.

If the initial cores show that dowel bars or tie bars are out of tolerance for alignment and the Engineer orders additional dowel or tie bar coring, full compensation for drilling the additional cores is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no additional compensation will be allowed therefor.

If the initial cores show that dowel bars or tie bars are within alignment tolerances and the Engineer orders more dowel or tie bar coring, the additional cores will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

The Department will not pay for additional coring to check dowel or tie bar alignment you request.

Full compensation for performing profilograph tests, furnishing the profilograms and electronic files to the Engineer, and for performing corrective work is included in the contract price paid per cubic yard for the type of concrete pavement as designated in the Verified Bid Item List and no additional compensation will be allowed therefor.

The contract prices paid per linear foot for seal pavement joint and seal isolation joint include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in sealing pavement joints and sealing isolation joints, complete in place, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

The contract price paid per station for shoulder rumble strip includes full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in constructing the rumble strip complete in place, as shown on the plans, as specified in these Standard Specifications and as directed by the Engineer.

AA

## **SECTION 41 PAVEMENT SUBSEALING AND JACKING**

**(Issued 01-05-07)**

### **In Section 41-1.02 replace the 2nd and 3rd paragraphs with:**

Cement for grout shall be Type II portland cement conforming to the provisions in Section 90-2.01A, "Cement."

Fly ash shall conform to the requirements in AASHTO Designation: M 295 for either Class C or for Class F. The brand of fly ash used in the work shall conform to the provisions for approval of admixture brands in Section 90-4.03, "Admixture Approval."



Chemical admixtures and calcium chloride may be used. Chemical admixtures in the grout mix shall conform to the provisions in Section 90-4, "Admixtures." Calcium chloride shall conform to ASTM Designation: D 98.

[illegible]

## SECTION 42 GROOVE AND GRIND PAVEMENT

**(Issued 05-15-09)**

**In Section 42-2.02 replace the 3rd paragraph with:**

Existing portland cement concrete pavement not constructed as part of the project shall be ground as follows:

Grinding shall be performed so that the pavement surface on both sides of all transverse joints and cracks has essentially the same depth of texture and does not vary from a true plane enough to permit a 0.006-foot thick shim 0.25-foot wide to pass under a 3-foot straightedge adjacent to either side of the joint or crack when the straightedge is laid on the pavement parallel to centerline with its midpoint at the joint or crack. After grinding has been completed, the pavement shall conform to the straightedge and profile requirements specified in Section 40-1.03, "Quality Control and Assurance."

Abnormally depressed areas due to subsidence or other localized causes will be excluded from testing with the profilograph and 12-foot straightedge specified in Section 40-1.03. The accumulated total of the excluded areas shall not exceed 5 percent of the total area to be ground. Profilograph testing shall end 25 feet prior to excluded areas and shall resume 25 feet following the excluded areas.

**In Section 42-2.03 replace the 2nd paragraph with:**

Replacement concrete paving shall conform to the provisions in Section 40, "Concrete Pavement." Replacement pavement may be spread and shaped by any suitable powered finishing machines, supplemented by handwork as necessary. Consolidation of the concrete shall be by means of high-frequency internal vibrators within 15 minutes after the concrete is deposited on the subgrade. Vibrating shall be done with care and in such manner to assure adequate consolidation adjacent to forms and uniformly across the full paving width. Use of vibrators for extensive shifting of the mass of concrete will not be permitted. Methods of spreading, shaping and compacting that result in segregation, voids or rock pockets shall be discontinued, and the Contractor shall adopt methods which will produce dense homogeneous pavement conforming to the required cross section. Finishing may be performed by hand method, as specified in Section 40-3.11B, "Stationary Side Form Finishing."

[illegible]

## SECTION 49 PILING

**(Issued 07-20-12)**

**In Section 49-1.03 replace the 4th paragraph with:**

Modification to the specified installation methods and specified pile tip elevation will not be considered at locations where settlement, tension demands, or lateral load demands control design pile tip elevations or when the plans state that specified pile tip elevation shall not be revised.

**In Section 49-1.03 in the 7th paragraph, replace the 2nd sentence with:**

The loading apparatus described as "Tensile Load Applied by Hydraulic Jack(s) Acting Upward at One End of Test Beam(s)" shall not be used.

**In Section 49-1.03 replace the 9th paragraph with:**

The Contractor shall furnish piling of sufficient length to obtain the specified tip elevation shown on the plans or specified in the special provisions.

The Contractor may use additional cementitious material in the concrete for the load test and anchor piles.

The drilling of holes shall conform to the provisions in these specifications. Concrete filling for cast-in-place concrete piles shall be prequalified in conformance with the provisions in Section 90-9, "Compressive Strength," and shall have a minimum 28-day compressive strength of 3,600 psi. At the option of the Contractor, the combined aggregate grading for the concrete shall be either the one-inch maximum grading, the 1/2-inch maximum grading, or the 3/8-inch maximum grading. Concrete shall conform to the provisions in Section 90, "Portland Cement Concrete," and Section 51, "Concrete Structures." Reinforcement shall conform to the provisions in Section 52, "Reinforcement."

The length of timber, steel, and precast prestressed concrete piles, and of cast-in-place concrete piles consisting of driven shells filled with concrete, shall be measured along the longest side, from the tip elevation shown on the plans to the plane of pile cut-off.

When pile tips are revised by the Engineer for timber, steel, and precast prestressed concrete piles, and for cast-in-place concrete piles consisting of driven shells filled with concrete, the additional length required, including all materials, equipment, and labor for furnishing, splicing, and installing the piling, will be paid for as extra work as provided in Section 4-1.03D, "Extra Work."

AA

**(Issued 04-20-12)**

The working drawings of the prestressing system shall show complete details and substantiating calculations of the method and materials the Contractor proposes to use in the prestressing operations, including any additions or rearrangement of reinforcing steel from that shown on the plans. The details shall outline the method and sequence of stressing and shall include complete specifications and details of the prestressing steel and anchoring devices, jacking stresses, elongation calculations, type of ducts and all other data pertaining to the prestressing, including the proposed arrangement of the prestressing steel in the members. The drawings shall also show (1) the exact location of anchorage system components, ducts, and other related elements and (2) the duct location data, including elevations at least every 1/8th point of the span for each span.

Prestressing steel shall be high-tensile wire conforming to the requirements in ASTM Designation: A 421, including Supplement I; high-tensile seven-wire strand conforming to the requirements in ASTM Designation: A 416; or uncoated deformed (Type II) high-strength steel bars conforming to the requirements in ASTM Designation: A 722, including all supplementary requirements. The maximum weight requirement of ASTM Designation: A 722 will not apply.

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**In Section 50-1.05 in the 3rd paragraph, replace item E with:**

- E. In addition to the requirements in Section 50-1.10, "Samples for Testing," four 4-foot-long samples of coated strand and one 5-foot-long sample of uncoated strand of each size and reel shall be furnished to the Engineer for testing. These samples, as selected by the Engineer, shall be representative of the material to be used in the work.

**In Section 50-1.05 between the 3rd and 4th paragraphs, add:**

The Contractor shall furnish to the Transportation Laboratory a representative 8-ounce sample from each batch of epoxy patching material to be used. Each sample shall be packaged in an airtight container identified with the manufacturer's name and batch number.

**In Section 50-1.07 replace the 2nd paragraph with:**

Ducts shall be fabricated with either welded or interlocked seams. Galvanizing of the welded seam will not be required. Ducts shall have sufficient strength to maintain their correct alignment during placing of concrete. Joints between sections of duct shall be positive metallic connections which do not result in angle changes at the joints. Waterproof tape shall be used at the connections. Ducts shall be bent without crimping or flattening. Transition couplings connecting the ducts to anchoring devices shall be either ferrous metal or polyolefin. Ferrous metal transition couplings need not be galvanized.

Ducts shall have an inside cross-sectional area of at least:

1. 2.5 times the net area of the prestressing steel for multistrand tendons that will be placed by the pull-through method.
2. 2.0 times the net area of the prestressing steel for multistrand tendons that will not be placed by the pull-through method.

Ducts shall have an outside diameter not exceeding 50 percent of the girder web width.

**In Section 50-1.07 replace the 7th paragraph with:**

All ducts having a vertical duct profile change of 6 inches or more shall be vented. Vents shall be placed within 6 feet of every high point in the duct profile. Vents shall be 1/2 inch minimum diameter standard pipe or suitable plastic pipe. Connections to ducts shall be made with metallic or plastic structural fasteners. Plastic components, if selected, shall not react with the concrete or enhance corrosion of the prestressing steel and shall be free of water soluble chlorides. The vents shall be mortar tight, taped as necessary, and shall provide means for injection of grout through the vents and for sealing the vents. Ends of vents shall be removed one inch below the roadway surface after grouting has been completed.

**In Section 50-1.08 replace the 2nd paragraph with:**

The maximum temporary tensile stress (jacking stress) in prestressing steel of post-tensioned members shall not exceed 75 percent of the specified minimum ultimate tensile strength of the prestressing steel.

**In Section 50-1.08 delete the 4th, 5th, and 6th paragraphs.**

**In Section 50-1.08 replace the 11th paragraph with:**

Prestressing forces shall not be applied to cast-in-place concrete until at least 10 days after the last concrete has been placed in the member to be prestressed and until the concrete compressive strength has reached the strength shown on the plans or specified in the specifications.

**In Section 50-1.08 replace the 15th paragraph with:**

When prestressing steel in pretensioned members is tensioned at a temperature appreciably lower than the estimated temperature of the concrete and the prestressing steel at the time of initial set of the concrete, the calculated elongation of the prestressing steel shall be increased to compensate for the loss in stress.

The maximum temporary tensile stress in the prestressing steel of pretensioned members shall not exceed 80 percent of the specified minimum ultimate tensile strength of the prestressing steel.

Pretensioned prestressing steel shall be anchored at stresses that will result in the ultimate retention of working forces at not less than those shown on the plans.

**In Section 50-1.09 replace the 2nd and 3rd paragraphs with:**

Grout shall consist of cement and water and may contain an admixture if approved by the Engineer.  
Cement shall conform to the provisions in Section 90-2.01A, "Cement."

**In Section 50-1.10 between the 3rd and 4th paragraphs, add:**

Each sample shall be identified by location and Contract number with weatherproof markings. A completed Sample Identification Card shall also be attached to each sample. The card is available from the Transportation Laboratory.

**In Section 50-1.10 in the 5th paragraph, replace item A with:**

A. For wire or bars, one 7-foot-long sample and for strand, one 4-foot-long sample, of each size shall be furnished for each heat or reel.

**In Section 50-1.11 replace the 1st paragraph with:**

No separate payment will be made for pretensioning precast concrete members. Payment for pretensioning precast concrete members shall be considered as included in the contract price paid for furnish precast members as provided for in Section 51, "Concrete Structures."

^^

**SECTION 51 CONCRETE STRUCTURES**  
**(Issued 08-05-11)**

**In Section 51-1.05 in the 11th paragraph, replace the 1st sentence with:**

Form panels for exposed surfaces shall be furnished and placed in uniform widths of not less than 3 feet and in uniform lengths of not less than 6 feet, except at the end of continuously formed surfaces where the final panel length required is less than 6 feet.

**In Section 51-1.06A(3) in the 1st paragraph, replace items E and F with:**

- E. When timber members are used to brace falsework bents which are located adjacent to roadways or railroads, all connections for the timber bracing shall be of the bolted type using 5/8-inch diameter or larger bolts or coil rod with a root diameter equal to that of the shank of a 5/8-inch diameter bolt.
- F. Falsework member clearances must be at least those shown in the following table:

| Falsework member | Clearances  |                                  |
|------------------|---|----------------------------------|
|                  | To railing members, barriers, and anchored temporary railings | To unanchored temporary railings |
| Footings         | 0'-3"   | 2'-0"                            |
| Piles            | 1'-0"   | 2'-9"                            |
| Other members    | 2'-0"   | 2'-9"                            |

**In Section 51-1.06C in the 11th paragraph, replace the 1st sentence with:**

Falsework for box culverts and other structures with decks lower than the roadway pavement and with span lengths of 14 feet or less shall not be released until the last placed concrete has attained a compressive strength of 1,600 psi, provided that curing of the concrete is not interrupted.

**In Section 51-1.11 replace the 6th paragraph with:**

Construction methods and equipment employed by the Contractor shall conform to the provisions in Section 7-1.02, "Load Limitations."

**In Section 51-1.12D replace the 4th paragraph with:**

Expanded polystyrene shall be a commercially available polystyrene board. Expanded polystyrene shall have a minimum flexural strength of 35 psi determined in conformance with the requirements in ASTM Designation: C 203 and a compressive yield strength of between 16 and 40 psi at 5 percent compression. Surfaces of expanded polystyrene against which concrete is placed shall be faced with hardboard. Hardboard shall be 1/8 inch minimum thickness, conforming to ANSI A135.4, any class. Other facing materials may be used provided they furnish equivalent protection. Boards shall be held in place by nails, waterproof adhesive, or other means approved by the Engineer.

**In Section 51-1.12F replace the 3rd paragraph with:**

Type A and AL joint seals shall consist of a groove in the concrete that is filled with field-mixed silicone sealant.

**In Section 51-1.12F in the 6th paragraph, replace the table with:**

| Movement Rating (MR)     | Seal Type   |
|--------------------------|---|
| MR ≤ 1 inch              | Type A or Type B                                    |
| 1 inch < MR ≤ 2 inches   | Type B  |
| 2 inches < MR ≤ 4 inches | Joint Seal Assembly (Strip Seal)                    |
| MR > 4 inches            | Joint Seal Assembly (Modular Unit) or Seismic Joint |

**In Section 51-1.12F(3)(a) replace the 1st and 2nd paragraphs with:**

The sealant must consist of a 2-component silicone sealant that will withstand up to ±50 percent movement. Silicone sealants must be tested under California Test 435 and must comply with the following:

| Specification   | Requirement                               |
|---|---|
| Modulus at 150 percent elongation                                     | 8-75 psi                                  |
| Recovery  | 21/32 inch max.                           |
| Notch Test  | Notched or loss of bond 1/4 inch, max.    |
| Water Resistance  | Notched or loss of bond 1/4 inch, max.    |
| Ultraviolet Exposure<br>ASTM Designation: G 154, Table X2.1, Cycle 2. | No more than slight checking or cracking. |
| Cone Penetration  | 4.5-12.0 mm                               |

**In Section 51-1.12F(3)(a) delete the 3rd and 8th paragraphs.**

**In Section 51-1.12F(3)(a) replace the 10th paragraph with:**

A Certificate of Compliance accompanied by a certified test report must be furnished for each batch of silicone sealant in conformance with the provisions in Section 6-1.07, "Certificates of Compliance."

**In Section 51-1.12F(3)(b) replace the 2nd paragraph with:**

The preformed elastomeric joint seal must conform to the requirements in ASTM D 2628 and the following:

1. The seal must consist of a multichannel, nonporous, homogeneous material furnished in a finished extruded form.
2. The minimum depth of the seal measured at the contact surface must be at least 95 percent of the minimum uncompressed width of the seal as designated by the manufacturer.
3. When tested in conformance with the requirements in California Test 673 for Type B seals, joint seals must provide a movement rating (MR) of not less than that shown on the plans.

4. The top and bottom edges of the joint seal must maintain continuous contact with the sides of the groove over the entire range of joint movement.
5. The seal must be furnished full length for each joint with no more than 1 shop splice in any 60-foot length of seal.
6. The Contractor must demonstrate the adequacy of the procedures to be used in the work before installing seals in the joints.
7. One field splice per joint may be made at locations and by methods approved by the Engineer. The seals are to be manufactured full length for the intended joint, then cut at the approved splice section and rematched before splicing. The Contractor must submit splicing details prepared by the joint seal manufacturer for approval before beginning splicing work.
8. Shop splices and field splices must have no visible offset of exterior surfaces and must show no evidence of bond failure.
9. At all open ends of the seal that would admit water or debris, each cell must be filled to a depth of 3 inches with commercial quality open cell polyurethane foam or closed by other means subject to approval by the Engineer.

**In Section 51-1.12F(3)(b) replace the 7th paragraph with:**

The joint seal must be installed full length for each joint with equipment that does not twist or distort the seal, elongate the seal longitudinally, or otherwise cause damage to the seal or to the concrete forming the groove.

**In Section 51-1.12F(3)(b) in the 11th paragraph, replace the 1st sentence with:**

Samples of the prefabricated joint seals, not less than 3 feet in length, will be taken by the Engineer from each lot of material.

**In Section 51-1.12H(1) in the 6th paragraph, replace the 4th and 5th sentences with:**

Each ply of fabric shall have a breaking strength of not less than 800 pounds per inch of width in each thread direction when 3" x 36" samples are tested on split drum grips. The bond between double plies shall have a minimum peel strength of 20 pounds per inch.

**In Section 51-1.12H(1) in the 8th paragraph in the table, replace the hardness (Type A) requirements with:**

|                   |                       |       |
|-------------------|-----------------------|-------|
| Hardness (Type A) | D 2240 with 2kg mass. | 55 ±5 |
|-------------------|-----------------------|-------|

**In Section 51-1.12H(2) in the 1st paragraph in item A, replace the 1st and 2nd sentences with:**

The bearings shall consist of alternating steel laminates and internal elastomer laminates with top and bottom elastomer covers. Steel laminates shall have a nominal thickness of 0.075 inch (14 gage).

**In Section 51-1.13 replace the 2nd, 3rd, and 4th paragraphs with:**

Surfaces of fresh concrete at horizontal construction joints shall be thoroughly consolidated without completely removing surface irregularities. Additionally, surfaces of fresh concrete at horizontal construction joints between girder stems and decks shall be roughened to at least a 1/4-inch amplitude.

Construction joint surfaces shall be cleaned of surface laitance, curing compound, and other foreign materials using abrasive blast methods before fresh concrete is placed against the joint surface.

Construction joint surfaces shall be flushed with water and allowed to dry to a surface dry condition immediately before placing concrete.

**In Section 51-1.135 replace the 1st paragraph with:**

Mortar shall be composed of cementitious material, sand, and water proportioned and mixed as specified in this Section 51-1.135.

**In Section 51-1.135 replace the 3rd paragraph with:**

The proportion of cementitious material to sand, measured by volume, shall be 1 to 2 unless otherwise specified.

**In Section 51-1.17 in 4th paragraph, replace the 3rd sentence with:**

The surfaces shall have a profile trace showing no high points in excess of 0.25 inch, and the portions of the surfaces within the traveled way shall have a profile count of 5 or less in any 100 foot section.

**Add:**

**51-1.17A Deck Crack Treatment**

The Contractor shall use all means necessary to minimize the development of shrinkage cracks.

The Contractor shall remove all equipment and materials from the deck and clean the surface as necessary for the Engineer to measure the surface crack intensity. Surface crack intensity will be determined by the Engineer after completion of concrete cure, before prestressing, and before the release of falsework. In any 500 square foot portion of deck within the limits of the new concrete deck, should the intensity of cracking be such that there are more than 50 feet of cracks whose width at any location exceeds 0.02 inch, the deck shall be treated with a high molecular weight methacrylate (HMWM) resin system. The area of deck to be treated shall have a width that extends for the entire width of new deck inside the concrete barriers and a length that extends at least 5 feet beyond the furthest single continuous crack outside the 500 square foot portion, measured from where that crack exceeds 0.02 inch in width, as determined by the Engineer.

Deck crack treatment shall include furnishing, testing, and applying the HMWM resin system, with sand and absorbent material. If grinding is required, deck crack treatment shall take place before grinding.

**51-1.17A(1) Submittals**

Submit a HMWM resin system placement plan. When HMWM resin is to be applied within 100 feet of a residence, business, or public space including sidewalks under a structure, also submit a public safety plan. Submit plans under Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The review time is 15 days.

The HMWM resin system placement plan must include:

1. Schedule of work and testing for each bridge
2. Description of equipment for applying HMWM resin
3. Range of gel time and final cure time for HMWM resin
4. Absorbent material to be used
5. Description of equipment for applying and removing excess sand and absorbent material
6. Procedure for removing HMWM resin from the deck, including equipment
7. Storage and handling of HMWM resin components and absorbent material
8. Disposal of excess HMWM resin and containers

The public safety plan must include:

1. A public notification letter with a list of delivery and posting addresses. The letter must state HMWM resin work locations, dates, times, and what to expect. Deliver the letter to residences and businesses within 100 feet of HMWM resin work locations and to local fire and police officials at least 7 days before starting work. Post the letter at the job site.
2. An airborne emissions monitoring plan prepared and executed by a certified industrial hygienist (CIH) certified in comprehensive practice by the American Board of Industrial Hygiene. The plan must have at least 4 monitoring points including the mixing point, application point, and point of nearest public contact. Monitor airborne emissions during HMWM resin work and submit emissions monitoring results after completing the work.
3. An action plan for protection of the public when airborne emissions levels exceed permissible levels.
4. A copy of the CIH's certification.

If the measures proposed in the safety plan are inadequate to provide for public safety associated with the use of HMWM resin, the Engineer will reject the plan and direct the Contractor to revise the plan. Directions for revisions will be in writing and include detailed comments. The Engineer will notify the Contractor of the approval or rejection of a submitted or revised plan within 15 days of receipt of that plan.

#### 51-1.17A(2) Quality Control and Assurance

Submit samples of HMWM resin components 15 days before use under Section 6-3, "Testing," of the Standard Specifications. Notify the Engineer 15 days before delivery of HMWM resin components in containers over 55 gallons to the job site.

Complete a test area before starting work. Results from airborne emissions monitoring of the test area must be submitted to the Engineer before starting production work.

The test area must:

1. Be approximately 500 square feet
2. Be placed within the project limits outside the traveled way at an approved location
3. Be constructed using the same equipment as the production work
4. Replicate field conditions for the production work
5. Demonstrate proposed means and methods meet the acceptance criteria
6. Demonstrate production work will be completed within the time allowed
7. Demonstrate suitability of the airborne emissions monitoring plan

The test area will be acceptable if:

1. The treated deck surface is tack free and non-oily
2. The sand cover adheres and resists brushing by hand
3. Excess sand and absorbent material has been removed
4. The coefficient of friction is at least 0.35 when tested under California Test 342

#### 51-1.17A(3) Materials

HMWM resin system consists of a resin, promoter, and initiator. HMWM resin must be low odor and comply with the following:

| HMWM Resin                                    |   |  |
|---|---|--|
| Property                                      | Requirement   | Test Method                                      |
| Volatile Content *                            | 30 percent, maximum   | ASTM D 2369                                      |
| Viscosity *                                   | 25 cP, maximum,<br>(Brookfield RVT with<br>UL adaptor,<br>50 RPM at 77°F) | ASTM D 2196                                      |
| Specific Gravity *                            | 0.90 minimum, at 77°F   | ASTM D 1475                                      |
| Flash Point *                                 | 180°F, minimum  | ASTM D 3278                                      |
| Vapor Pressure *                              | 1.0 mm Hg, maximum,<br>at 77°F  | ASTM D 323                                       |
| Tack-free Time                                | 400 minutes,<br>maximum, at 25°C  | Specimens prepared<br>per California<br>Test 551 |
| PCC Saturated<br>Surface-Dry Bond<br>Strength | 3.5 MPa, minimum at<br>24 hours and 21 ± 1°C                              | California Test 551                              |

\*Test must be performed before adding initiator.

Sand for abrasive sand finish must:

1. Be commercial quality dry blast sand
2. Have at least 95 percent pass the No. 8 sieve and at least 95 percent retained on the No. 20 sieve when tested under California Test 205

Absorbent material must be diatomaceous earth, abrasive blast dust, or substitute recommended by the HMWM resin supplier and approved by the Engineer.

#### 51-1.17A(4) Construction

HMWM resin system applied by machine must be:





## SECTION 52 REINFORCEMENT

(Issued 06-05-09)

**In Section 52-1.02(B) between the 3rd and 4th paragraphs, add:**

The epoxy powder coating shall be selected from the Department's Pre-Qualified Products List.

**In Section 52-1.02(B) replace the 14th paragraph with:**

Except for lap splices, splices for epoxy-coated reinforcement shall be coated with a corrosion protection covering that is selected from the Department's Pre-Qualified Products List. The covering shall be installed in accordance with the manufacturer's recommendations.

**In Section 52-1.07 in the 11th paragraph, replace the table with:**

| Height Zone (H)<br>(Feet above ground) | Wind Pressure Value<br>(psf) |
|--|------------------------------|
| $H \leq 30$                            | 20                           |
| $30 < H \leq 50$                       | 25                           |
| $50 < H \leq 100$                      | 30                           |
| $H > 100$                              | 35                           |

**In Section 52-1.08B(1) replace the 1st paragraph with:**

Mechanical splices to be used in the work shall be selected from the Department's Pre-Qualified Products List.

**In Section 52-1.08B(1) in the 2nd paragraph, replace the table with:**

| Reinforcing Bar Number | Total Slip |
|------------------------|------------|
| 4                      | 0.020-inch |
| 5                      | 0.020-inch |
| 6                      | 0.020-inch |
| 7                      | 0.028-inch |
| 8                      | 0.028-inch |
| 9                      | 0.028-inch |
| 10                     | 0.036-inch |
| 11                     | 0.036-inch |
| 14                     | 0.048-inch |
| 18                     | 0.060-inch |

**In Section 52-1.08B(1), in the 6th paragraph, delete item C.**

**In Section 52-1.08B(2) in the 6th paragraph, replace the subparagraph with:**

The minimum preheat and interpass temperatures shall be 400° F for Grade 40 bars and 600° F for Grade 60 bars. Immediately after completing the welding, at least 6 inches of the bar on each side of the splice shall be covered by an insulated wrapping to control the rate of cooling. The insulated wrapping shall remain in place until the bar has cooled below 200° F.

**Replace Section 52-1.08B(3) with:**

### **52-1.08B(3) Resistance Butt Welds**

Shop produced resistance butt welds shall be produced by a fabricator who is selected from the Department's Pre-Qualified Products List.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," shall be furnished for each shipment of splice material. The Certificate of Compliance shall include heat number, lot number and mill certificates.

**In Section 52-1.08C replace the 3rd paragraph with:**

Testing on prequalification and production sample splices shall be performed at an approved independent testing laboratory. The laboratory shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors who will provide other services or materials for the project.

The independent testing laboratory shall be selected from the Department's Pre-Qualified Products List.

**In Section 52-1.08C replace the 5th paragraph with:**

Prequalification and production sample splices and testing shall conform to California Test 670 and these specifications.

**In Section 52-1.08C delete the 6th paragraph.**

**In Section 52-1.08C replace the 8th paragraph with:**

Each sample splice, as defined herein, shall be identified as representing either a prequalification or production test sample splice.

**In Section 52-1.08C in the 10th paragraph, delete the last sentence.**

**Replace Section 52-1.08C(1) with:**

**52-1.08C(1) Splice Prequalification Report**

Before using any service splices or ultimate butt splices in the work, the Contractor shall submit a Splice Prequalification Report. The report shall include the following:

- A. A copy of the manufacturer's product literature giving complete data on the splice material and installation procedures.
- B. Names of the operators who will be performing the splicing.
- C. Descriptions of the positions, locations, equipment, and procedures that will be used in the work.
- D. Certifications from the fabricator for prequalification of operators and procedures based on sample tests performed no more than 2 years before submitting the report. Each operator shall be certified by performing 2 sample splices for each bar size of each splice type that the operator will be performing in the work. For deformation-dependent types of splice devices, each operator shall be certified by performing 2 additional samples for each bar size and deformation pattern that will be used in the work.

Prequalification sample splices shall be tested by an approved independent testing laboratory and shall conform to the appropriate production test criteria and slip requirements specified herein. When epoxy-coated reinforcement is required, resistance butt welded sample splices shall have the weld flash removed by the same procedure as will be used in the work, before coating and testing. The Splice Prequalification Report shall include the certified test results for all prequalification sample splices.

The QCM shall review and approve the Splice Prequalification Report before submitting it to the Engineer for approval. The Contractor shall allow 2 weeks for the review and approval of a complete report before performing any service splicing or ultimate butt splicing in the work.

**In Section 52-1.08C(2)(a) replace the 1st, 2nd, 3rd, 4th, and 5th paragraphs with:**

Production tests shall be performed by an approved independent testing laboratory for all service splices used in the work. A production test shall consist of testing 4 sample splices prepared for each lot of completed splices. The samples shall be prepared by the Contractor using the same splice material, position, operators, location, and equipment, and following the same procedure as used in the work.

At least one week before testing, the Contractor shall notify the Engineer in writing of the date and location where the testing of the samples will be performed.

The 4 samples from each production test shall be securely bundled together and identified with a completed sample identification card before shipment to the approved independent testing laboratory. The card will be furnished by the Engineer. Bundles of samples containing fewer than 4 samples of splices shall not be tested.

Before performing any tensile tests on production test sample splices, one of the 4 samples shall be tested for, and shall conform to, the requirements for total slip in Section 52-1.08B(1), "Mechanical Splices." Should this sample not meet the total slip requirements, one retest, in which the 3 remaining samples are tested for total slip, will be allowed. Should any of the 3 remaining samples not conform to the total slip requirements, all splices in the lot represented by this production test will be rejected.

If 3 or more sample splices from a production test conform to the provisions in this Section 52-1.08C(2), "Service Splice Test Criteria," all splices in the lot represented by this production test will be considered acceptable.

**Replace Section 52-1.08C(2)(b) with:**

**52-1.08C(2)(b) Quality Assurance Test Requirements for Service Splices**

In addition to the required production tests, the Contractor shall concurrently prepare 4 service quality assurance sample splices for:

- A. The first production test performed.
- B. One of every 5 subsequent production tests, or fraction thereof, randomly selected by the Engineer.

These service quality assurance sample splices shall be prepared in the same manner as specified herein for service production sample splices.

The service quality assurance sample splices shall be shipped to the Transportation Laboratory for quality assurance testing. Each set of 4 sample splices shall be securely bundled together and identified by location and contract number with weatherproof markings before shipment. Bundles containing fewer than 4 samples of splices will not be tested. Sample splices not accompanied by the supporting documentation required in Section 52-1.08B(1), "Mechanical Splices," for mechanical splices, or in Section 52-1.08B(3), "Resistance Butt Welds," for resistance butt welds, will not be tested.

Quality assurance testing will be performed in conformance with the requirements for service production sample splices in Section 52-1.08C(2)(a), "Production Test Requirements for Service Splices."

**Replace Section 52-1.08C(3) with:**

**52-1.08C(3) Ultimate Butt Splice Test Criteria**

Ultimate production and quality assurance sample splices shall be tensile tested in conformance with the requirements described in ASTM Designation: A 370 and California Test 670.

Each sample splice shall be identified as representing a prequalification, production, or quality assurance sample splice.

The portion of hoop reinforcing bar, removed to obtain a sample splice, shall be replaced using a prequalified ultimate mechanical butt splice, or the hoop shall be replaced in kind.

Reinforcing bars, other than hoops, from which sample splices are removed, shall be repaired using ultimate mechanical butt splices conforming to the provisions in Section 52-1.08C(1), "Splice Prequalification Report," or the bars shall be replaced in kind. These bars shall be repaired or replaced such that no splices are located in any "No Splice Zone" shown on the plans.

Ultimate production and quality assurance sample splices shall rupture either: 1) in the reinforcing bar but outside of the affected zone, provided that the sample splice has visible necking or 2) anywhere, provided that the sample splice has achieved the strain requirement for necking.

When tested in conformance with the requirements in California Test 670, "Necking (Option I)," the visible necking shall be such that there is a visible decrease in the sample's cross-sectional area at the point of rupture.

When tested in conformance with the requirements in California Test 670, "Necking (Option II)," the strain requirement for necking shall be such that the largest measured strain is not less than 6 percent for No. 11 and larger bars, or not less than 9 percent for No. 10 and smaller bars.

The affected zone is the portion of the reinforcing bar where any properties of the bar, including the physical, metallurgical, or material characteristics, have been altered by fabrication or installation of the splice. The weld and one inch adjacent to the weld will be considered part of the affected zone.

**In Section 52-1.08C(3)(a) replace the 1st paragraph with:**

Production tests shall be performed for all ultimate butt splices used in the work. A production test shall consist of testing 4 sample splices removed from each lot of completed splices.

**In Section 52-1.08C(3)(a) replace the 3rd paragraph with:**

After notification has been received, the Engineer will randomly select the 4 sample splices to be removed from the lot and place tamper-proof markings or seals on them. These ultimate production sample splices shall be removed by the Contractor, and tested by an approved independent testing laboratory.

**In Section 52-1.08(C)(3)(a) replace the 5th, 6th, and 7th paragraphs with:**

A sample splice will be rejected if a tamper-proof marking or seal is disturbed before testing.

The 4 sample splices from each production test shall be securely bundled together and identified with a completed sample identification card before shipment to the approved independent testing laboratory. The card will be furnished by the Engineer. Bundles of samples containing fewer than 4 sample splices shall not be tested.

Before performing any tensile tests on production test sample splices, one of the 4 sample splices shall be tested for, and shall conform to, the requirements for total slip in Section 52-1.08B(1), "Mechanical Splices." Should this sample splice not meet these requirements, one retest, in which the 3 remaining sample splices are tested for total slip, will be allowed. Should any of the 3 remaining sample splices not conform to these requirements, all splices in the lot represented by this production test will be rejected.

**Replace Section 52-1.08C(3)(b) with:**

**52-1.08C(3)(b) Quality Assurance Test Requirements for Ultimate Butt Splices**

In addition to the required production tests, the Contractor shall concurrently prepare 4 ultimate quality assurance sample splices for:

- A. The first production test performed.
- B. One of every 5 subsequent production tests, or fraction thereof, randomly selected by the Engineer.

These ultimate quality assurance sample splices shall be prepared in the same manner as specified herein for ultimate production sample splices.

The ultimate quality assurance sample splices shall be shipped to the Transportation Laboratory for quality assurance testing. Each set of 4 sample splices shall be securely bundled together and identified by location and contract number with weatherproof markings before shipment. Bundles containing fewer than 4 samples of splices will not be tested. Sample splices not accompanied by the supporting documentation required in Section 52-1.08B(1), "Mechanical Splices," for mechanical splices, or in Section 52-1.08B(3), "Resistance Butt Welds," for resistance butt welds, will not be tested.

Quality assurance testing will be performed in conformance with the requirements for ultimate production sample splices in Section 52-1.08C(3)(a), "Production Test Requirements for Ultimate Butt Splices."

**Replace Section 52-1.08D with:**

A Production Test Report for all testing performed on each lot shall be prepared by the approved independent testing laboratory performing the testing and submitted to the QCM for review and approval. The report shall be signed by an engineer who represents the laboratory and is registered as a Civil Engineer in the State of California. The report shall include, as a minimum, the following information for each test: contract number, bridge number, lot number and location, bar size, type of splice, length of mechanical splice, length of test specimen, physical condition of test sample splice, any notable defects, total measured slip, and ultimate tensile strength of each splice. In addition, the report shall include location of visible necking area and largest measured strain for ultimate butt splices.

The QCM must review, approve, and forward each Production Test Report to the Engineer for review before the splices represented by the report are encased in concrete. The Engineer will have 3 working days to review each Production Test Report and respond in writing after a complete report has been received. Should the Contractor elect to encase any splices before receiving notification from the Engineer, it is expressly understood that the Contractor will not be relieved of the responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Material not conforming to these requirements will be subject to rejection.

Quality assurance test results for each bundle of 4 samples of splices will be reported in writing to the Contractor within 3 working days after receipt of the bundle by the Transportation Laboratory. In the event that more than one bundle is received on the same day, 2 additional working days shall be allowed for providing test results for each additional bundle received. A test report will be made for each bundle received. Should the Contractor elect to encase splices before receiving notification from the Engineer, it is expressly understood that the

Contractor will not be relieved of the responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Material not conforming to these requirements will be subject to rejection.

^^

**SECTION 53 SHOTCRETE**  
**(Issued 11-02-07)**

**In Section 53-1.01 replace the 3rd paragraph with:**

The dry-mix process shall consist of delivering dry mixed aggregate and cementitious material pneumatically or mechanically to the nozzle body and adding water and mixing the materials in the nozzle body. The wet-mix process shall consist of delivering mixed aggregate, cement, and water pneumatically to the nozzle and adding any admixture at the nozzle.

**In Section 53-1.02 replace the 1st through 4th paragraphs with:**

Cementitious material, fine aggregate, and mixing water shall conform to the provisions in Section 90, "Portland Cement Concrete."

Shotcrete to be mixed and applied by the dry-mix process shall consist of one part cementitious material to not more than 4.5 parts fine aggregate, thoroughly mixed in a dry state before being charged into the machine. Measurement may be either by volume or by weight. The fine aggregate shall contain not more than 6 percent moisture by weight.

Shotcrete to be mixed and applied by the wet-mix process shall consist of cementitious material, fine aggregate, and water and shall contain not less than 632 pounds of cementitious material per cubic yard. A maximum of 30 percent pea gravel may be substituted for fine aggregate. The maximum size of pea gravel shall be such that 100 percent passes the 1/2 inch screen and at least 90 percent passes the 3/8 inch screen.

Admixtures may be added to shotcrete and shall conform to the provisions in Section 90-4, "Admixtures."

**In Section 53-1.04 in the 3rd paragraph, replace item C with:**

- C. Aggregate and cementitious material that have been mixed for more than 45 minutes shall not be used unless otherwise permitted by the Engineer.

**Replace Section 53-1.07 with:**

**53-1.07 MEASUREMENT**

Quantities of shotcrete will be measured by the cubic yard computed from measurements, along the slope, of actual areas placed and the theoretical thickness shown on the plans. The Department does not pay for shotcrete placed outside the dimensions shown on the plans or to fill low foundation.

**Replace Section 53-1.08 with:**

**53-1.08 PAYMENT**

The contract price paid per cubic yard for shotcrete shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in placing shotcrete, including preparing the foundation, wire reinforcement, structure backfill, joint filling material, and if required by the plans, drains with sacked pervious backfill material, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

^^

## SECTION 54 WATERPROOFING

(Issued 07-01-11)

### In Section 54-1.02, replace the 1st paragraph with:

Waterproofing asphalt shall conform to the requirements in ASTM Designation: D 449, Type I for below ground and Type II for above ground.

^^

## SECTION 55 STEEL STRUCTURES

(Issued 08-05-11)

### In Section 55-1.01 replace the 4th paragraph with:

Design details, fabrication, and workmanship for steel railway bridges shall conform to the provisions in Chapter 15, "Steel Structures," of the AREMA Manual for Railway Engineering.

### In Section 55-1.05 replace the 3rd paragraph with:

Construction methods and equipment employed by the Contractor shall conform to the provisions in Section 7-1.02, "Load Limitations."

### In Section 55-2.01 replace the table in the 5th paragraph with:

| Material Conforming to<br>ASTM Designation: A 709/A 709M | CVN Impact Value<br>(Ft. Lbs at Temp.) |
|--|--|
| Grade 36   | 15 at 40° F                            |
| Grade 50* (2 inches and under in thickness)              | 15 at 40° F                            |
| Grade 50W* (2 inches and under in thickness)             | 15 at 40° F                            |
| Grade 50* (Over 2 inches to 4 inches in thickness)       | 20 at 40° F                            |
| Grade 50W* (Over 2 inches to 4 inches in thickness)      | 20 at 40° F                            |
| Grade HPS 50W* (4 inches and under in thickness)         | 20 at 10° F                            |
| Grade HPS 70W (4 inches and under in thickness)          | 25 at -10° F                           |
| Grade 100 (2 1/2 inches and under in thickness)          | 25 at 0° F                             |
| Grade 100W (Over 2 1/2 inches to 4 inches in thickness)  | 35 at 0° F                             |

\* If the yield point of the material exceeds 65,000 psi, the temperature for the CVN impact value for acceptability shall be reduced 15° F for each increment of 10,000 psi above 65,000 psi

**In Section 55-2.01 replace the Structural Steel Materials table with:**

| Structural Steel Materials  |  |
|---|--|
| Material  | Specification  |
| Structural steel:   |  |
| Carbon steel  | ASTM: A 709/A 709M, Grade 36 or {A 36/A 36M} <sup>a</sup>                    |
| High strength low alloy columbium vanadium steel  | ASTM: A 709/A 709M, Grade 50 or {A 572/A 572M, Grade 50} <sup>a</sup>        |
| High strength low alloy structural steel  | ASTM: A 709/A 709M, Grade 50W, Grade HPS 50W, or {A 588/A 588M} <sup>a</sup> |
| High strength low alloy structural steel plate  | ASTM: A 709/A 709M, Grade HPS 70W  |
| High-yield strength, quenched and tempered alloy steel plate suitable for welding         | ASTM: A 709/A 709M, Grade 100 and Grade 100W, or {A 514/A 514M} <sup>a</sup> |
| Steel fastener components for general applications:                                       |  |
| Bolts and studs   | ASTM: A 307  |
| Anchor bolts  | ASTM: F 1554 or A 307, Grade C   |
| High-strength bolts and studs   | ASTM: A 449, Type 1  |
| High-strength threaded rods   | ASTM: A 449, Type 1  |
| High-strength nonheaded anchor bolts  | ASTM: F 1554, Grade 105, Class 2A  |
| Nuts  | ASTM: A 563, including Appendix X1 <sup>b</sup>                              |
| Washers   | ASTM: F 844  |
| Components of high-strength steel fastener assemblies for use in structural steel joints: |  |
| Bolts   | ASTM: A 325, Type 1  |
| Tension control bolts   | ASTM: F 1852, Type 1   |
| Nuts  | ASTM: A 563, including Appendix X1 <sup>b</sup>                              |
| Hardened washers  | ASTM : F 436, Type 1, Circular, including S1 supplementary requirements      |
| Direct tension indicators   | ASTM: F 959, Type 325, zinc-coated   |
| Carbon steel for forgings, pins and rollers   | ASTM: A 668/A 668M, Class D  |
| Alloy steel for forgings  | ASTM: A 668/A 668M, Class G  |
| Pin nuts  | ASTM: A 36/A 36M   |
| Carbon-steel castings   | ASTM: A 27/A 27M, Grade 65-35, Class 1                                       |
| Malleable iron castings   | ASTM: A 47/A 47M, Grade 32510 (Grade 22010)                                  |
| Gray iron castings  | ASTM: A 48, Class 30B  |
| Carbon steel structural tubing  | ASTM: A 500, Grade B or A 501  |
| Steel pipe (Hydrostatic testing will not apply)   | ASTM: A 53, Type E or S, Grade B; A 106, Grade B; or A 139, Grade B          |
| Stud connectors   | AASHTO/AWS D1.5  |

a Grades that may be substituted for the equivalent ASTM Designation: A 709 steel, at the Contractor's option, subject to the modifications and additions specified and to the requirements of A 709.

b Zinc-coated nuts that will be tightened beyond snug or wrench tight shall be furnished with a dry lubricant conforming to Supplementary Requirement S2 in ASTM Designation: A 563.

**In Section 55-2.04 delete the 1st paragraph.**

**Delete Section 55-2.05.**

**In Section 55-3.05 replace the 1st paragraph with:**

Surfaces of bearing and base plates and other metal surfaces that are to come in contact with each other or with ground concrete surfaces shall be flat to within 1/32-inch tolerance in 12 inches and to within 1/16-inch tolerance overall. Surfaces of bearing and base plates and other metal bearing surfaces that are to come in contact with preformed fabric pads, elastomeric bearing pads, or mortar shall be flat to within 1/8-inch tolerance in 12 inches and to within 3/16-inch tolerance overall.



B. The radius of bend measured to the concave face shall conform to the requirements in ASTM Designation: A6/A6M

B. Internal threads shall conform to the requirements in ASTM Designation: A 563.

**In Section 56-1.02E replace the 1st paragraph with:**

Pipe posts shall be welded or seamless steel pipe conforming to the requirements in ASTM Designation: A 53/A 53M, Grade B; ASTM Designation: A 106/A 106M, Grade B; or API Specification 5L PSL2 Grade B or Grade X42R or Grade X42M. At the option of the Contractor, posts may be fabricated from structural steel conforming to the requirements in ASTM Designation: A 36/A 36M.

Pipe posts shall not be spiral seam welded.

**In Section 56-1.02F replace item B of the 1st paragraph with:**

- B. Material for gratings shall be structural steel conforming to the requirements in ASTM Designation: A 1011/A 1011M, Designation CS, Type B or Designation SS, Grade 36, Type 1.

**In Section 56-1.03 replace the 5th paragraph with:**

Clips, eyes, or removable brackets shall be affixed to all signs and all posts and shall be used to secure the sign during shipping and for lifting and moving during erection as necessary to prevent damage to the finished galvanized or painted surfaces. Brackets on tubular sign structures shall be removed after erection. Details of the devices shall be shown on the working drawings.

**In Section 56-1.03 delete the 12th paragraph.**

**In Section 56-1.05 replace the 1st paragraph with:**

Excepting tubular type, all ferrous metal parts of sign structures shall be galvanized and not painted, unless otherwise specified in the special provisions.

**In Section 56-1.05 replace the 2nd paragraph with:**

Except as herein provided, all exterior surfaces including those areas to be covered by sign panels of tubular type of sign structures shall be cleaned and painted as provided in Section 59-5, "Painting Sign Structures," and as provided in the special provisions. There shall be no chemical treatment of galvanized surfaces prior to cleaning and painting. Walkway gratings, walkway brackets, gutters, safety railings, steel mountings for light fixtures, and all nuts, bolts, and washers for sign structures shall be galvanized after fabrication and shall not be painted.

**In Section 56-1.05 replace the 3rd paragraph with:**

Galvanizing shall conform to the provisions in Section 75-1.05, "Galvanizing," except that when permission is granted by the Engineer, surfaces may be coated with zinc by the metalizing process. Metalizing shall be performed in conformance with the AWS requirements. The thickness of the sprayed zinc coat shall be  $10 \pm 2$  mils. The thickness of the sprayed zinc coat on faying surfaces shall not be more than 10 mils.

**In Section 56-1.05, add:**

Zinc solders or zinc alloys that contain tin shall not be used to repair a damaged galvanized surface.

**In Section 56-1.07, add:**

Bridge-mounted signs shall not be fastened to concrete elements of bridges or railings before the concrete attains a compressive strength of 2,500 psi.

**In Section 56-1.10 replace the 4th paragraph with:**

The contract price paid per pound for install sign structure of the type or types designated in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in installing sign structures, complete in place, including installing anchor bolt assemblies, removable sign panel frames, and sign panels and performing any welding, painting or galvanizing required during installation, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

Backfill material for metal posts shall consist of minor concrete conforming to the provisions in Section 90-10, "Minor Concrete," and shall contain not less than 463 pounds of cementitious material per cubic yard.

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Pressure washing includes cleaning surfaces using a pressure wash system with a nozzle pressure from 2,500 to 5,000 psi and a maximum fan tip angle of 45 degrees.

Steam cleaning includes cleaning dirt, grease, loose chalky paint, and other foreign material from surfaces using steam. The steam temperature at the nozzle shall be from 265 to 375 degrees F. A biodegradable detergent shall be used during steam cleaning. After steam cleaning, cleaned surfaces shall be rinsed clean with fresh water. Steam cleaning shall not be performed more than 2 weeks before painting or other phases of cleaning. Steam-cleaned surfaces shall not be painted until they are thoroughly dry and 24 hours have elapsed after steam cleaning.

**In Section 59-2.12 replace the 3rd and 4th paragraphs with:**

Contact surfaces of stiffeners, railings, built up members or open seam exceeding 6 mils in width that would retain moisture, shall be caulked with polysulfide or polyurethane sealing compound conforming to the requirements in ASTM Designation: C 920, Type S, Grade NS, Class 25, Use O, or other approved material.

The dry film thickness of the paint will be measured in place with a calibrated Type 2 magnetic film thickness gage in conformance with the requirements in SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages," of the "SSPC: The Society for Protective Coatings," except that there shall be no limit to the number or location of spot measurements to verify compliance with specified thickness requirements.

**In Section 59-5.01 replace the 1st paragraph with:**

Tubular sign structures shall be cleaned and painted in conformance with the provisions in Section 59-1, "General," and this Section 59-5. Sign structures, other than tubular sign structures, shall not be painted unless otherwise specified in the special provisions.

AA

## SECTION 63: CAST-IN-PLACE CONCRETE PIPE

**(Issued 10-21-11)**

**Replace Section 63 with:**

**SECTION 63: (BLANK)**

AA

## SECTION 64 PLASTIC PIPE

**(Issued 06-05-09)**

**In Section 64-1.02 replace the 5th paragraph with:**

HDPE compounds used in the manufacture of corrugated polyethylene pipe and fittings shall comply with AASHTO M 294 except that the mix shall contain not less than 2 nor greater than 4 percent well dispersed carbon black. HDPE compounds used in the manufacture of ribbed profile wall polyethylene pipe shall comply with ASTM F 894 except that Type E ultraviolet stabilizers shall not be allowed and carbon black shall be well dispersed in an amount not less than 2 percent nor greater than 4 percent.

Manufacturers of corrugated polyethylene pipe shall:

1. Participate in the National Transportation Product Evaluation Control Program (NTPEP) for each plant supplying corrugated polyethylene pipe and fittings for the project.
2. Conduct and maintain a quality control program under NTPEP.



**In Section 65-1.035 replace the 3rd paragraph with:**

The surface of the concrete backfill shall be broomed with a heavy broom to produce a uniform rough surface if hot mix asphalt is to be placed directly thereon.

**Replace Section 65-1.05 with:**

**65-1.05 (BLANK)**

**In Section 65-1.06 in the 2nd paragraph, replace the 1st subparagraph with:**

Cement Mortar. - Mortar shall be composed of one part cementitious material and 2 parts sand by volume. Supplementary cementitious material will not be required.

**In Section 65-1.10 in the 1st paragraph in the 1st sentence, delete "jacked reinforced concrete pipe."**

**In Section 65-1.10 delete the 2nd paragraph.**

^^

## **SECTION 66 CORRUGATED METAL PIPE**

**(Issued 07-20-12)**

**In Section 66-1.045 replace the 1st paragraph with:**

At locations where pipe is to be backfilled with concrete as shown on the plans, the concrete backfill shall be constructed of minor concrete or Class 4 concrete conforming to the provisions in Section 90, "Portland Cement Concrete." Minor concrete shall contain not less than 380 pounds of cementitious material per cubic yard. The concrete to be used will be designated in the contract item or shown on the plans.

**In Section 66-1.045 replace the 3rd paragraph with:**

The surface of the concrete backfill shall be broomed with a heavy broom to produce a uniform rough surface if hot mix asphalt is to be placed directly thereon.

**Replace Section 66-3.10 with:**

**66-3.10 (BLANK)**

**In Section 66-4.02 delete the 2nd paragraph.**

^^

## **SECTION 68 SUBSURFACE DRAINS**

**(Issued 07-31-07)**

**In Section 68-3.02D replace the 1st and 2nd paragraphs with:**

Concrete for splash pads shall be produced from minor concrete conforming to the provisions in Section 90-10, "Minor Concrete." Minor concrete shall contain not less than 470 pounds of cementitious material per cubic yard.

Mortar placed where edge drain outlets and vents connect to drainage pipe and existing drainage inlets shall conform to the provisions in Section 51-1.135, "Mortar."

**In Section 68-3.03 replace the 13th paragraph with:**

Cement treated permeable material, which is not covered with hot mix asphalt within 12 hours after compaction of the permeable material, shall be cured by either sprinkling the material with a fine spray of water every 4 hours during daylight hours or covering the material with a white polyethylene sheet, not less than 6 mils thick. The above curing requirements shall begin at 7:00 a.m. on the morning following compaction of the cement treated permeable material and continue for the next 72 hours or until the material is covered with hot mix asphalt, whichever is less. The cement treated permeable material shall not be sprayed with water during the first 12 hours after compacting, but may be covered with the polyethylene sheet during the first 12 hours or prior to the beginning of the cure period.

**In Section 68-3.03 replace the 17th and 18th paragraphs with:**

Hot mix asphalt for backfilling trenches in existing paved areas shall be produced from commercial quality aggregates and asphalt and mixed at a central mixing plant. The aggregate shall conform to the 3/4 inch grading, or the 1/2 inch grading for Type A and Type B hot mix asphalt specified in Section 39-1.02E, "Aggregate." The amount of asphalt binder to be mixed with the aggregate shall be between 4 percent and 7 percent by weight of the dry aggregate, as determined by the Engineer.

Hot mix asphalt backfill shall be spread and compacted in approximately 2 equal layers by methods that will produce a hot mix asphalt surfacing of uniform smoothness, texture and density. Each layer shall be compacted before the temperature of the mixture drops below 250 °F. Prior to placing the hot mix asphalt backfill, a tack coat of asphaltic emulsion conforming to the provisions in Section 94, "Asphaltic Emulsions," shall be applied to the vertical edges of existing pavement at an approximate rate of 0.05 gallon per square yard.

**In Section 68-3.03 replace the 20th paragraph with:**

Type A pavement markers conforming to the details shown on the plans and the provisions in Section 85, "Pavement Markers," shall be placed on paved shoulders or dikes at outlet, vent and cleanout locations as directed by the Engineer. The waiting period for placing pavement markers on new hot mix asphalt surfacing will not apply.

**Replace Section 68-3.05 with:**

### 68-3.05 PAYMENT

The contract price paid per linear foot for plastic pipe (edge drain) of the size or sizes shown in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in installing edge drains complete in place, including excavation (and removal of any concrete deposits that may occur along the lower edge of the concrete pavement in Type 1 installations) and hot mix asphalt backfill for Type 1 edge drain installation, tack coat, filter fabric, and treated permeable material, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The contract price paid per linear foot for plastic pipe (edge drain outlet) of the size or sizes shown in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in installing edge drain outlets, vents and cleanouts complete in place, including outlet and vent covers, expansion plugs, pavement markers, concrete splash pads, connecting outlets and vents to drainage facilities, and excavation and backfill [aggregate base, hot mix asphalt, tack coat, and native material] for outlets, vents, and cleanouts to be installed in embankments and existing shoulders, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

AA

## SECTION 69 OVERSIDE DRAINS

**(Issued 07-31-07)**

**In Section 69-1.01 replace the 1st paragraph with:**

This work shall consist of furnishing and installing entrance tapers, pipe downdrains, tapered inlets, flume downdrains, anchor assemblies, reducers, slip joints and hot mix asphalt overside drains to collect and carry surface

drainage down the roadway slopes as shown on the plans or as directed by the Engineer and as specified in these specifications and the special provisions.

**Replace Section 69-1.02D with:**

**69-1.02D Hot Mix Asphalt**

Hot mix asphalt for overside drains shall conform to the provisions in Section 39-1.13, "Miscellaneous Areas."

**Replace Section 69-1.04 with:**

**69-1.04 HOT MIX ASPHALT OVERSIDE DRAINS**

Hot mix asphalt overside drains shall be constructed as shown on the plans or as directed by the Engineer. The hot mix asphalt shall be placed in conformance with the provisions in Section 39-1.13, "Miscellaneous Areas."

**In Section 69-1.06 replace the 2nd paragraph with:**

Quantities of hot mix asphalt placed for overside drains will be paid for as provided in Section 39-5, "Measurement and Payment," for hot mix asphalt placed in miscellaneous areas.

^^

**SECTION 70 MISCELLANEOUS FACILITIES**

**(Issued 01-20-12)**

**In Section 70-1.02C replace the 2nd paragraph with:**

Precast concrete flared end sections shall conform to the requirements for Class III Reinforced Concrete Pipe in AASHTO Designation: M 170M. Cementitious materials and aggregate shall conform to the provisions in Section 90-2, "Materials," except that grading requirements shall not apply to the aggregate. Use of supplementary cementitious material shall conform to the requirements in AASHTO Designation: M 170. The area of steel reinforcement per linear foot of flared end section shall be at least equal to the minimum steel requirements for circular reinforcement in circular pipe for the internal diameter of the circular portion of the flared end section. The basis of acceptance of the precast concrete flared end section shall conform to the requirements of Section 5.1.2 of AASHTO Designation: M 170.

**In Section 70-1.02C replace the 3rd paragraph with:**

Plastic flared end sections shall conform to the requirements in ASTM Designation: D 3350.

**In Section 70-1.02H replace the 1st paragraph with:**

Precast concrete pipe risers and pipe reducers, and precast concrete pipe sections, adjustment rings and tapered sections for pipe energy dissipators, pipe inlets and pipe manholes shall conform to the requirements in AASHTO Designation: M 199M/M 199, except that the cementitious material and aggregate shall conform to the provisions in Section 90-2, "Materials," except that grading requirements shall not apply to the aggregate. Use of supplementary cementitious material shall conform to the requirements in AASHTO Designation: M 170.

**In Section 70-1.03 replace the 2nd paragraph with:**

Cutoff walls for precast concrete flared end sections shall be constructed of minor concrete conforming to the provisions in Section 90-10, "Minor Concrete." Minor concrete shall contain not less than 470 pounds of cementitious material per cubic yard.



**SECTION 72 SLOPE PROTECTION**  
(Issued 07-20-12)

**In Section 74-1.02 delete the 2nd paragraph.**

^^

**SECTION 75 MISCELLANEOUS METAL**  
**(Issued 07-01-11)**

**In Section 75-1.02 replace the 6th paragraph with:**

Manhole frames and covers shall conform to AASHTO M 306.

**In Section 75-1.02 replace the 10th paragraph with:**

Unless otherwise specified, materials shall conform to the following specifications:

| Material  | Specification   |
|---|---|
| Steel bars, plates and shapes   | ASTM Designation: A 36/A 36M or A 575, A 576 (AISI or M Grades 1016 through 1030)   |
| Steel fastener components for general applications:                                       |   |
| Bolts and studs   | ASTM Designation: A 307   |
| Headed anchor bolts   | ASTM Designation: A 307, Grade B, including S1 supplementary requirements   |
| Nonheaded anchor bolts  | ASTM Designation: F 1554 or A 307, Grade C, including S1 supplementary requirements and S1.6 of AASHTO Designation: M 314 supplementary requirements, or AASHTO Designation: M 314, Grade 36 or 55, including S1 supplementary requirements |
| High-strength bolts and studs, threaded rods, and nonheaded anchor bolts                  | ASTM Designation: A 449, Type 1   |
| Nuts  | ASTM Designation: A 563, including Appendix X1*   |
| Washers   | ASTM Designation: F 844   |
| Components of high-strength steel fastener assemblies for use in structural steel joints: |   |
| Bolts   | ASTM Designation: A 325, Type 1   |
| Tension control bolts   | ASTM Designation: F 1852, Type 1  |
| Nuts  | ASTM Designation: A 563, including Appendix X1*   |
| Hardened washers  | ASTM Designation: F 436, Type 1, Circular, including S1 supplementary requirements  |
| Direct tension indicators   | ASTM Designation: F 959, Type 325, zinc-coated  |
| Stainless steel fasteners (Alloys 304 & 316) for general applications:                    |   |
| Bolts, screws, studs, threaded rods, and nonheaded anchor bolts                           | ASTM Designation: F 593 or F 738M   |
| Nuts  | ASTM Designation: F 594 or F 836M   |
| Washers   | ASTM Designation: A 240/A 240M and ANSI B 18.22M  |
| Carbon-steel castings   | ASTM Designation: A 27/A 27M, Grade 65-35, Class 1  |
| Malleable iron castings   | ASTM Designation: A 47, Grade 32510 or A 47M, Grade 22010   |
| Gray iron castings<br>Inside a roadbed<br>Outside a roadbed                               | AASHTO M 306<br>AASHTO M306 except only AASHTO M105, Class 35B is allowed   |
| Ductile iron castings   | ASTM Designation: A 536, Grade 65-45-12   |
| Cast iron pipe  | Commercial quality  |
| Steel pipe  | Commercial quality, welded or extruded  |
| Other parts for general applications  | Commercial quality  |

\*Zinc-coated nuts that will be tightened beyond snug or wrench tight shall be furnished with a dyed dry lubricant conforming to Supplementary Requirement S2 in ASTM Designation: A 563.

**In Section 75-1.03 replace the 13th paragraph with:**

Concrete anchorage devices shall be mechanical expansion or resin capsule types installed in drilled holes or cast-in-place insert types. The anchorage devices shall be selected from the Department's Pre-Qualified Products List. The qualification requirements for concrete anchorage devices may be obtained from the Pre-Qualified Products List Web site.

The anchorage devices shall be a complete system, including threaded studs, hex nuts, and cut washers. Thread dimensions for externally threaded concrete anchorage devices prior to zinc coating shall conform to the requirements in ASME Standard: B1.1 having Class 2A tolerances or ASME Standard: B1.13M having Grade 6g tolerances. Thread dimensions for internally threaded concrete anchorage devices shall conform to the requirements in ASTM A 563.

**In Section 75-1.03 replace the 18th paragraph with:**

Mechanical expansion anchors shall, when installed in accordance with the manufacturer's instructions and these specifications and tested in conformance with the requirements in California Test 681, withstand the application of a sustained tension test load of at least the following values for at least 48 hours with a movement not greater than 0.035 inch:

| Stud Diameter<br>(inches) | Sustained<br>Tension Test<br>Load<br>(pounds) |
|---------------------------|---|
| *3/4                      | 5,000   |
| 5/8                       | 4,100   |
| 1/2                       | 3,200   |
| 3/8                       | 2,100   |
| 1/4                       | 1,000   |

\* Maximum stud diameter permitted for mechanical expansion anchors.

Resin capsule anchors shall, when installed in accordance with the manufacturer's instructions and these specifications and tested in conformance with the requirements in California Test 681, withstand the application of a sustained tension test load of at least the following values for at least 48 hours with a movement not greater than 0.010 inch:

| Stud Diameter<br>(inches) | Sustained<br>Tension Test<br>Load<br>(pounds) |
|---------------------------|---|
| 1-1/4                     | 31,000  |
| 1                         | 17,900  |
| 7/8                       | 14,400  |
| 3/4                       | 5,000   |
| 5/8                       | 4,100   |
| 1/2                       | 3,200   |
| 3/8                       | 2,100   |
| 1/4                       | 1,000   |

At least 25 days before use, the Contractor shall submit one sample of each resin capsule anchor per lot to the Transportation Laboratory for testing. A lot of resin capsule anchors is 100 units, or fraction thereof, of the same brand and product name.

**In Section 75-1.03 replace the 20th paragraph with:**

A Certificate of Compliance for concrete anchorage devices shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance."

Sealing compound, for caulking and adhesive sealing, shall be a polysulfide or polyurethane material conforming to the requirements in ASTM Designation: C 920, Type S, Grade NS, Class 25, Use O.

## **SECTION 83 RAILINGS AND BARRIERS**

**(Issued 07-01-11)**

### **In Section 83-1.02 replace the 7th paragraph with:**

Mortar shall conform to the provisions in Section 51-1.135, "Mortar," and shall consist of one part by volume of cementitious material and 3 parts of clean sand.

### **In Section 83-1.02B in the 24th paragraph in the 8th subparagraph, replace the 1st sentence with:**

Anchor cable shall be 3/4 inch preformed, 6 x 19, wire strand core or independent wire rope core (IWRC), galvanized in conformance with the requirements in Federal Specification RR-W-410, right regular lay, manufactured of improved plow steel with a minimum breaking strength of 23 tons.

### **In Section 83-1.02E in the 6th paragraph, replace the 2nd sentence with:**

Cable shall be galvanized in conformance with the requirements in Federal Specification RR-W-410.

### **In Section 83-1.02I replace the 5th paragraph with:**

Where shown on the plans, cables used in the frame shall be 5/16 inch in diameter, wire rope, with a minimum breaking strength of 5,000 pounds and shall be galvanized in conformance with the requirements in Federal Specification RR-W-410.

### **In Section 83-1.02I replace the 14th paragraph with:**

Chain link fabric shall be 11-gage conforming to one of the following:

1. AASHTO Designation: M181, Type I, Class C
2. AASHTO Designation: M181, Type IV, Class A
3. ASTM F 1345, Class 2

### **In Section 83-2.02D(1) replace the 5th paragraph with:**

When concrete barriers are to be constructed on existing structures, the dowels shall be bonded in holes drilled in the existing concrete. Drilling of holes and bonding of dowels shall conform to the following:

1. The bonding materials shall be either magnesium phosphate concrete, modified high alumina based concrete or portland cement based concrete. Magnesium phosphate concrete shall be either single component (water activated) or dual component (with a prepackaged liquid activator). Modified high alumina based concrete and portland cement based concrete shall be water activated. Bonding materials shall conform to the following requirements:

| Property                            | Test Method                | Requirements |
|-------------------------------------|----------------------------|--------------|
| Compressive Strength                |                            |              |
| at 3 hours, MPa                     | California Test 551        | 21 min.      |
| at 24 hours, MPa                    | California Test 551        | 35 min.      |
| Flexure Strength                    |                            |              |
| at 24 hours, MPa                    | California Test 551        | 3.5 min.     |
| Bond Strength: at 24 hours          |                            |              |
| SSD Concrete, MPa                   | California Test 551        | 2.1 min.     |
| Dry Concrete, MPa                   | California Test 551        | 2.8 min.     |
| Water Absorption, %                 | California Test 551        | 10 max.      |
| Abrasion Resistance                 |                            |              |
| at 24 hours, grams                  | California Test 550        | 25 max.      |
| Drying Shrinkage at 4 days, %       | ASTM Designation:<br>C 596 | 0.13 max.    |
| Soluble Chlorides by weight, %      | California Test 422        | 0.05 max.    |
| Water Soluble Sulfates by weight, % | California Test 417        | 0.25 max.    |

2. Magnesium phosphate concrete shall be formulated for minimum initial set time of 15 minutes and minimum final set time of 25 minutes at 70° F. The materials, prior to use, shall be stored in a cool, dry environment.
3. Mix water used with water activated material shall conform to the provisions in Section 90-2.03, "Water."
4. The quantity of water for single component type or liquid activator (for dual component type) to be blended with the dry component, shall be within the limits recommended by the manufacturer and shall be the least amount required to produce a pourable batter.
5. Addition of retarders, when required and approved by the Engineer, shall be in conformance with the manufacturer's recommendations.
6. Before using concrete material that has not been previously approved, a minimum of 45 pounds shall be submitted to the Engineer for testing. The Contractor shall allow 45 days for the testing. Each shipment of concrete material that has been previously approved shall be accompanied by a Certificate of Compliance as provided in Section 6-1.07, "Certificates of Compliance."
7. Magnesium phosphate concrete shall not be mixed in containers or worked with tools containing zinc, cadmium, aluminum or copper metals. Modified high alumina based concrete shall not be mixed in containers or worked with tools containing aluminum.
8. The surface of any dowel coated with zinc or cadmium shall be coated with a colored lacquer before installation of the dowel. The lacquer shall be allowed to dry thoroughly before embedment of the dowels.
9. The holes shall be drilled by methods that will not shatter or damage the concrete adjacent to the hole. The diameter of the drilled hole shall be 1/2 inch larger than the nominal diameter of the dowels.
10. The drilled holes shall be clean and dry at the time of placing the bonding material and the steel dowels. Bonding material and dowel shall completely fill the drilled hole. The surface temperature shall be 40° F or above when the bonding material is placed.
11. After bonding, dowels shall remain undisturbed for a minimum of 3 hours or until the bonding material has reached a strength sufficient to support the dowels. Dowels that are improperly bonded, as determined by the Engineer, shall be removed. The holes shall be cleaned or new holes shall be drilled and the dowels replaced and securely bonded to the concrete. Removing, redrilling and replacing improperly bonded dowels shall be performed at the Contractor's expense. Modified high alumina based concrete and portland cement based concrete shall be cured in conformance with the provisions in Section 90-7.01B, "Curing Compound Method," of the Standard Specifications. Magnesium phosphate concrete shall not be cured.

**In Section 83-2.02D(1) replace the 8th paragraph with:**

Granular material for backfill between the 2 walls of concrete barrier (Types 50E, 60F, 60GE and 60SF), as shown on the plans, shall be placed without compaction.

**In Section 83-2.02D(2) in the 1st paragraph, replace item b with:**

- b. If the 3/8-inch maximum size aggregate grading is used to construct extruded or slip-formed concrete barriers, the cementitious material content of the minor concrete shall be not less than 675 pounds per cubic yard.

**In Section 83-2.02D(2) replace the 3rd paragraph with:**

The concrete paving between the tops of the 2 walls of concrete barrier (Types 50E, 60F, 60GE, and 60SF) and the optional concrete slab at the base between the 2 walls of concrete barrier (Types 50E, 60F, 60GE, and 60SF) shall be constructed of minor concrete conforming to the provisions of Section 90-10, "Minor Concrete," except that the minor concrete shall contain not less than 505 pounds of cementitious material per cubic yard.

**In Section 83-2.02D(2) replace the 8th paragraph with:**

Granular material for backfill between the 2 walls of concrete barrier (Types 50E, 60F, 60GE and 60SF) shall be earthy material suitable for the purpose intended, having no rocks, lumps or clods exceeding 1-1/2 inches in greatest dimension.

**In Section 83-2.03 replace the 8th and 9th paragraphs with:**

Concrete barriers, except Type 50E, Type 60F, Type 60GE, and Type 60SF will be measured along the top of the barrier.

Concrete barriers Type 50E, Type 60F, Type 60GE, and Type 60SF will be measured once along the centerline between the 2 walls of the barrier.

**In Section 83-2.04 replace the 3rd paragraph with:**

The contract prices paid per linear foot for concrete barrier of the type or types listed in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in constructing the concrete barriers, complete in place, including bar reinforcing steel, steel dowels and drilling and bonding dowels in structures, hardware for steel plate barrier, miscellaneous metal, excavation, backfill (including concrete paving for, and granular material or concrete slab used as backfill in Type 50E, Type 60F, Type 60GE, and Type 60SF concrete barrier), and disposing of surplus material and for furnishing, placing, removing and disposing of the temporary railing for closing the gap between existing barrier and the concrete barrier being constructed, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

^^

**SECTION 85 PAVEMENT MARKERS**

**(Issued 07-31-07)**

**In Section 85-1.06 replace the 6th paragraph with:**

Pavement markers shall not be placed on new hot mix asphalt surfacing or seal coat until the surfacing or seal coat has been opened to public traffic for a period of not less than 7 days when hot melt bituminous adhesive is used, and not less than 14 days when epoxy adhesive is used.

**In Section 85-1.06 in the 14th paragraph, replace the 2nd sentence with:**

Cleaning shall be done by blast cleaning on all surfaces regardless of age or type, except that blast cleaning of clean, new hot mix asphalt and clean, new seal coat surfaces will not be required when hot melt bituminous adhesive is used.

^^

**SECTION 86 SIGNALS, LIGHTING AND ELECTRICAL SYSTEMS**

**(Issued 01-20-12)**



**Replace Section 86 with:**  
**SECTION 86 ELECTRICAL SYSTEMS**  
**86-1 GENERAL**

**86-1.01 DESCRIPTION**

Section 86 includes specifications for installing, modifying, and removing:

1. Traffic signal
2. Interconnect system
3. Ramp metering system
4. Flashing beacon system
5. Lighting system
6. Sign illumination system
7. Traffic monitoring station
8. Communication system
9. Electrical equipment in structure
10. Falsework lighting

Comply with Part 4 of the California MUTCD. Nothing in this Section 86 is to be construed as to reduce the minimum standards in this manual.

The locations of electrical system elements are approximate; the Engineer will approve final location.

**86-1.015 DEFINITIONS**

Definitions pertain only to Section 86, "Electrical Systems."

**actuation:** As defined in the California MUTCD.

**channel:** Discrete information path.

**controller assembly:** Controller unit and auxiliary equipment housed in a rainproof cabinet to control a system's operations.

**controller unit:** Part of the controller assembly performing the basic timing and logic functions.

**detector:** As defined in the California MUTCD.

**electrolier:** Complete assembly of lighting standard and luminaire.

**flasher:** Device to open and close signal circuits at a repetitive rate.

**flashing beacon control assembly:** Switches, circuit breakers, terminal blocks, flasher, wiring, and necessary electrical components all housed in a single enclosure to properly operate a beacon.

**inductive loop detector:** Detector capable of being actuated by inductance change caused by vehicle passing or standing over the loop.

**lighting standard:** Pole and mast arm supporting the luminaire.

**luminaire:** Assembly that houses the light source and controls the light emitted from the light source.

**magnetic detector:** Detector capable of being actuated by induced voltage caused by vehicle passing through the earth's magnetic field.

**powder coating:** A coating applied electrostatically using UV-stable polymer exterior grade powder.

**pre-timed controller assembly:** Operates traffic signals under a predetermined cycle length.

**signal face:** As defined in the California MUTCD.

**signal head:** As defined in the California MUTCD.

**signal indication:** As defined in the California MUTCD.

**signal section:** As defined in the California MUTCD.

**signal standard:** Pole and mast arm supporting one or more signal faces with or without a luminaire mast arm.

**traffic-actuated controller assembly:** Operates traffic signals under the varying demands of traffic as registered by detector actuation.

**traffic phase:** Signal phase as defined in the California MUTCD.

**vehicle:** As defined in the California Vehicle Code.

**86-1.02 REGULATIONS AND CODE** Electrical equipment must comply with one or more of the following:

1. ANSI
2. ASTM
3. 8 CA Code of Regs § 2299 et seq.
4. EIA
5. NEMA

6. NETA
7. UL

Materials and workmanship must comply with:

1. FCC
2. ITE
3. NEC
4. NRTL
5. Public Utilities Commission, General Order No. 95, "Rules for Overhead Electrical Line Construction"
6. Public Utilities Commission, General Order No. 128, "Rules for Construction of Underground Electric Supply and Communication Systems"

#### **86-1.03 COST BREAK-DOWN**

Determine quantities required to complete work. Submit the quantities as part of the cost breakdown.

The sum of the amounts for the units of work listed in the cost breakdown must equal the contract lump sum price bid for the work. Include overhead and profit for each unit of work listed in the cost breakdown. If mobilization is a bid item, include bond premium, temporary construction facilities, and material plants into the mobilization bid item, otherwise, include in each unit of work listed in the cost breakdown. Do not include costs for traffic control system in the cost breakdown.

The cost breakdown may be used to determine partial payment and to calculate payment adjustments for additional costs incurred due to a change order. If a change order increases or decreases the quantities, payment adjustment may be determined under Section 4-1.03B, "Increased or Decreased Quantities."

The cost breakdown must include type, size, and installation method for:

1. Foundations
2. Standards and poles
3. Conduit
4. Pull boxes
5. Conductors and cables
6. Service equipment enclosures
7. Telephone demarcation cabinet
8. Signal heads and hardware
9. Pedestrian signal heads and hardware
10. Pedestrian push buttons
11. Loop detectors
12. Luminaires and lighting fixtures

#### **86-1.04 EQUIPMENT LIST AND DRAWINGS**

Within 15 days of contract approval, submit for review a list of equipment and materials that you propose to install. Comply with Section 5-1.02, "Plans and Working Drawings." The list must include:

1. Name of manufacturer
2. Dimension
3. Item identification number
4. List of components

The list must be supplemented by other data as required, including:

1. Schematic wiring diagrams
2. Scale drawings of cabinets showing location and spacing of shelves, terminal blocks, and equipment, including dimensioning
3. Operation manual

Submit 2 copies of the above data. The Engineer will review within 15 days.

Electrical equipment that is manufactured as detailed on the plans will not require detailed drawings and diagrams.

Furnish 3 sets of computer-generated cabinet schematic wiring diagrams.

The cabinet schematic wiring diagram must be placed in a heavy duty plastic envelope and attached to the inside of the door of each cabinet.

Prepare diagrams, plans, and drawings using graphic symbols in IEEE 315, "Graphic Symbols for Electrical and Electronic Diagrams."

#### **86-1.05 CERTIFICATE OF COMPLIANCE**

Submit a Certificate of Compliance for all electrical material and equipment to the Engineer under Section 6-1.07, "Certificates of Compliance."

#### **86-1.06 MAINTAINING EXISTING AND TEMPORARY ELECTRICAL SYSTEMS**

Keep existing electrical system or approved temporary replacement in working order during the progress of the work. Shutdown is allowed for alteration or removal of the system. Traffic signal shutdown must be limited to normal working hours. Lighting system shutdown must not interfere with the regular lighting schedule.

Notify the Engineer before performing work on the existing system.

Notify the local traffic enforcement agency before traffic signal shutdown.

If existing or temporary system must be modified, work not shown on the plans or specified in the special provisions, but required to keep the system in working order will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

The State or local agency will:

1. Continue the operation and maintenance of existing electrical facilities
2. Continue to provide electrical energy to operate existing electrical facilities
3. Repair or replace existing facilities damaged by public traffic
4. Pay for electrical energy to operate existing or new facilities undergoing the functional tests described in Section 86-2.14C, "Functional Testing"

Verify location and depth of existing detectors, conduits, pull boxes, and other electrical facilities before using tools or equipment that may damage those facilities or interfere with an electrical system.

Notify the Engineer immediately if existing facility is damaged by your activities. Repair or replace damaged facility promptly. If you fail to complete the repair or replacement, promptly, the State will repair or replace and deduct the costs.

Damaged detectors must be replaced within 24 hours at your expense. If you fail to complete the repair within 24 hours, the State will repair and deduct the repair costs.

If roadway remains open to traffic while an existing lighting system is modified:

1. Keep existing system in working order
2. Make final connection so the modified circuit is in operation by nightfall

Keep temporary electrical installations in working order until no longer required. Remove temporary installations as specified in Section 86-7, "Removing, Reinstalling or Salvaging Electrical Equipment."

These provisions do not void your responsibilities as specified in Section 7-1.12, "Indemnification and Insurance," and Section 7-1.16, "Contractor's Responsibility for the Work and Materials."

During traffic signal system shutdown, place W3-1a, "STOP AHEAD," and R1-1, "STOP," signs in each direction to direct traffic through the intersection. For 2-lane approaches, place 2 R1-1 signs.

W3-1a and R1-1 signs must comply with Section 12-3.06, "Construction Area Signs." Use a minimum size of 30 inches for the R1-1 sign.

Cover signal faces when the system is shut down overnight. Cover temporary W3-1a and R1-1 signs when the system is turned on.

#### **86-1.07 SCHEDULING OF WORK**

Except service installation and service equipment enclosure, do not work above ground until all materials are on hand to complete electrical work at each location. Schedule work to allow each system to be completed and ready for operation before opening the corresponding section of the roadway to traffic.

If street lighting exists or is installed in conjunction with traffic signals, do not turn on the signals until the street lighting is energized.

Traffic signals will not be placed in operation until the roadways to be controlled are open to public traffic.

Lighting and traffic signals, including flashing operation, will not be placed in operation before starting the functional test period specified in Section 86-2.14, "Testing."

Do not pull conductors into conduit until:

1. Pull boxes are set to grade
2. Metallic conduit is bonded

In vehicular undercrossings, soffit lights must be in operation as soon as practicable after falsework has been removed from the structure. Lighting for pedestrian structures must be in operation before opening the structure to pedestrian traffic.

If the Engineer orders soffit lights or lighting for pedestrian structures to be activated before permanent power service is available, the cost of installing and removing temporary power service will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

The initial traffic signal turn-on must be made between 9:00 a.m. and 2:00 p.m. Before the initial turn-on, all equipment, including pedestrian signals, pedestrian push buttons, vehicle detectors, lighting, signs, and pavement delineation must be installed and in working order. Direct louvers, visors, and signal faces to maximize visibility.

Start functional tests on any working day except Friday or the day before a legal holiday. You must notify the Engineer 48 hours before the start of functional test.

## **86-1.08 (BLANK)**

## **86-2 MATERIALS AND INSTALLATION**

### **86-2.01 EXCAVATING AND BACKFILLING**

Dispose of surplus excavated material under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way."

Backfill as specified in Section 19-3, "Structure Excavation and Backfill." Compact backfill in conduit trenches outside the hinge point of slopes and not under pavement to a minimum relative compaction of 90 percent. Compact backfill within hinge points and in areas where pavement is to be constructed to a minimum relative compaction of 95 percent.

Backfill trenches and restore sidewalk, pavement, and landscaping at one intersection before starting excavation at another intersection.

If excavating on a street or highway, restrict closure to 1 lane at a time.

### **86-2.02 REMOVING AND REPLACING IMPROVEMENTS**

Replace or reconstruct sidewalk, curb, gutter, concrete pavement, asphalt concrete pavement, underlying material, lawn, plant, and other facilities damaged by your activities. Replacement material must be of equal or better quality than the material replaced. Work must be in a serviceable condition.

If a part of a square or slab of concrete sidewalk, curb, gutter, or driveway is broken or damaged, the entire square or slab must be removed and reconstructed.

Cut outline of PCC sidewalk or driveway to be removed:

1. Using a power-driven saw
2. On a neat line
3. To a 0.17-foot minimum depth

### **86-2.03 FOUNDATIONS**

Except for concrete for cast-in-drilled-hole concrete pile foundation, PCC must comply with Section 90-10, "Minor Concrete."

Construct concrete foundation on firm ground.

After each post, standard, and pedestal is properly positioned, place mortar under the base plate. Finish exposed portion to present a neat appearance. Mortar must comply with Section 51-1.135, "Mortar," except mortar must have:

1. 1 part by volume of cementitious material
2. 3 parts by volume of clean sand

Reinforced cast-in-drilled-hole concrete pile foundation must comply with Section 49, "Piling," except:

1. Material resulting from drilling holes must be disposed of as specified in Section 86-2.01, "Excavating and Backfilling"

2. Concrete for cast-in-drilled-hole concrete pile will not be considered as designated by compressive strength

Form exposed portion of the foundation to present a neat appearance and true to line and grade. The top of a foundation for post and standard must be finished to curb or sidewalk grade. Forms must be rigid and securely braced in place. Conduit ends and anchor bolts must be placed at proper height and position. Anchor bolts must be installed a maximum of 1:40 from vertical and held in place by rigid top and bottom templates. Use a steel bottom template at least 1/2 inch thick that provides proper spacing and alignment of anchor bolts near the embedded bottom end. Install bottom template before placing footing concrete.

Provide new foundation and anchor bolts of the proper type and size for relocated standards.

Steel parts must be galvanized as specified in Section 75-1.05, "Galvanizing."

Provide 2 nuts and washers for the upper threaded part of each anchor bolt. Provide 3 nuts and washers for each anchor bar or stud.

Do not weld high-strength steel used for anchor bolt, anchor bar, or stud.

Before placing concrete, moisten forms and ground. Keep forms in place until the concrete sets for at least 24 hours and is strong enough to prevent damage to surface.

Except if located on a structure, construct foundation for post, standard, and pedestal monolithically.

Apply ordinary surface finish as specified in Section 51-1.18A, "Ordinary Surface Finish."

If a foundation must be extended for additional depth, the extension work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

Do not erect post, pole, standard, pedestal, or cabinet until the foundation is set for a minimum of 7 days.

The Engineer will choose the plumbing or raking technique for posts, standards, and pedestals. Plumb or rake by adjusting the leveling nuts before tightening nuts. Do not use shims or similar devices. After final adjustments of both top nuts and leveling nuts on anchorage assemblies have been made, and each post, standard, and pedestal on structure is properly positioned, tighten nuts as follows:

1. Tighten leveling nuts and top nuts, following a crisscross pattern, until bearing surfaces of all nuts, washers, and base plates are in firm contact.
2. Use an indelible marker to mark the top nuts and base plate with lines showing relative alignment of the nut to the base plate.
3. Tighten top nuts, following a crisscross pattern, an additional 1/6th of a turn.

In unpaved areas, construct a raised PCC pad in front of each controller cabinet.

Completely remove foundations not to be reused or abandoned.

If abandoning a foundation, remove the top of foundation, anchor bolts, and conduits to a minimum depth of 0.5 foot below sidewalk surface or original ground. Backfill the resulting hole with material equivalent to the surrounding material.

#### **86-2.04 STANDARDS, STEEL PEDESTALS AND POSTS**

Bolts, including anchor bolts, nuts, and washers for signal and lighting support structures must comply with Section 55-2, "Materials." Except for bearing-type connection or slip-base, high-strength bolted connection must comply with Section 55-3.14, "Bolted Connections." Welding, nondestructive testing of welds, and acceptance and repair criteria for steel member nondestructive testing must comply with American Welding Society (AWS) D1.1.

Using stainless steel rivets, attach rectangular corrosion-resistant metal identification tag on all standards and poles, except Type 1:

1. Above the hand hole, near the base of standards and poles
2. On the underside of mast arms near the arm plate

The lettering on each identification tag must be depressed or raised, 1/4 inch tall, legible, and include the following information:

1. Name of the manufacturer
2. Date of manufacture
3. Identification number
4. Contract number
5. Unique identification code that is:
  - 5.1. Assigned by the manufacturer
  - 5.2. Traceable to a particular contract and the welds on that component

5.3. Readable after the support structure is coated and installed

Type 1 standard and steel pedestal for controller cabinet must be manufactured of one of the following:

1. 0.12-inch or thicker galvanized steel
2. 4-inch standard weight galvanized steel pipe as specified in ASTM A 53
3. 4-inch Type 1 conduit with the top designed for post-top slip-fitter

Ferrous metal parts of a standard that has a shaft length of 15 feet or longer must comply with the provisions in Section 55-2, "Materials," and the following:

1. Standard must be manufactured from sheet steel of weldable grade having a minimum yield strength of 40,000 psi after manufacturing.
2. Certified test report verifying compliance with minimum yield strength requirements must be submitted. Test report may be the mill test report for the as-received steel or if the as-received steel has a lower yield strength than required you must provide test data assuring that your method of cold forming will consistently increase the tensile properties of the steel to meet the specified minimum yield strength. Test data must include tensile properties of the steel after cold forming for specific heats and thicknesses.
3. If a single-ply 5/16-inch thick pole is specified, a 2-ply pole with equivalent section modulus may be substituted.
4. Standard may be manufactured of full-length sheets or shorter sections. Each section must be manufactured from 1 or 2 pieces of sheet steel. If 2 pieces are used, the longitudinal welded seams must be directly opposite from one another. If the sections are butt-welded together, the longitudinal welded seams of adjacent sections must be placed to form continuous straight seams from base to top of standard.
5. Butt-welded circumferential joints of tubular sections requiring CJP groove welds must be made using a metal sleeve backing ring inside each joint. The sleeve must be 1/8 inch nominal thickness, or thicker, and manufactured from steel having the same chemical composition as the steel in the tubular sections to be joined. If the sections to be joined have different specified minimum yield strengths, the steel in the sleeve must have the same chemical composition as the tubular section having the higher minimum yield strength. The width of the metal sleeve must be consistent with the type of nondestructive testing selected and must be a minimum width of 1 inch. At fitting time, the sleeve must be centered at the joint and in contact with the tubular section at the point of the weld.
6. Welds must be continuous.
7. Weld metal at the transverse joint must extend to the sleeve, making the sleeve an integral part of the joint.
8. During manufacturing, longitudinal seams on vertical tubular members of cantilevered support structures must be centered on and along the side of the pole that the pole plate is located. Longitudinal seams on horizontal tubular members, including signal and luminaire arms, must be within  $\pm 45$  degrees of the bottom of the arm.
9. Longitudinal seam weld in steel tubular section may be made by the electric resistance welding process.
10. Longitudinal seam weld must have 60 percent minimum penetration, except:
  - 10.1. Within 6 inches of circumferential weld, longitudinal seam weld must be CJP groove weld.
  - 10.2. Longitudinal seam weld on lighting support structure having telescopic pole segment splice must be CJP groove weld on the female end for a length on each end equal to the designated slip-fit splice length plus 6 inches.
11. Exposed circumferential weld, except fillet and fatigue-resistant weld, must be ground flush with the base metal before galvanizing or painting. Ground flush is specified as -0, +0.08-inch.
12. Circumferential weld and base plate-to-pole weld may be repaired only one time.
13. Exposed edges of the plates that make up the base assembly must be finished smooth and exposed corners of the plates must be broken. Provide shafts with slip-fitter shaft caps.
14. Surface flatness requirements of ASTM A 6 apply to plates:
  - 14.1. In contact with concrete, grout, or washers and leveling nuts
  - 14.2. In high-strength bolted connections
  - 14.3. In joints, where cap screws are used to secure luminaire and signal arms
  - 14.4. Used for breakaway slip-base assemblies

15. Standard must be straight with a maximum variation of:

- 15.1. 1 inch measured at the midpoint of a 30-foot to 35-foot standard
  - 15.2. 3/4 inch measured at the midpoint of a 17-foot to 20-foot standard
  - 15.3. 1 inch measured 15 feet above the base plate for Type 35 and Type 36 standards
- 16. Zinc-coated nuts used on fastener assemblies having a specified preload obtained by specifying a prescribed tension, torque value, or degree of turn must be provided with a colored lubricant, clean and dry to the touch. The lubricant color must contrast the zinc coating color on the nut so the presence of the lubricant is visually obvious. Lubricant must be insoluble in water or the fastener components must be shipped to the job site in a sealed container.
  - 17. Do not make additional holes in structural members.
  - 18. Standard with an outside diameter of 12 inches or less must be round. Standard with an outside diameter greater than 12 inches must be round or multisided. Multisided standard must be convex with a minimum of 12 sides and have a minimum bend radius of 4 inches.
  - 19. Manufacture mast arm from material specified for standard.
  - 20. Manufacture cast steel option for slip base from material of Grade 70-40, as specified in ASTM A 27/A 27M. Other comparable material may be used if approved by the Engineer. The casting tolerances must comply with the Steel Founders' Society of America's recommendations for green sand molding.
  - 21. One casting from each lot of a maximum of 50 castings must be radiographed as specified in ASTM E 94. Casting must comply with the acceptance criteria for severity level 3 or better for the types and categories of discontinuities in ASTM E 186 and E 446. If the casting fails the inspection, 2 additional castings must be radiographed. If the 2 additional castings fail the inspection, the entire lot will be rejected.
  - 22. Material certification, consisting of physical and chemical properties, and radiographic film of the casting must be filed at the manufacturer's office. Certification and film must be available for inspection.
  - 23. High-strength bolts, nuts, and flat washers used to connect slip-base plate must comply with ASTM A 325 or A 325M and be galvanized as specified in Section 75-1.05, "Galvanizing."
  - 24. Plate washers must be manufactured by saw cutting and drilling steel plate. Steel plate must comply with AISI 1018 and be galvanized as specified in Section 75-1.05, "Galvanizing." Before galvanizing, remove burrs and sharp edges and chamfer both sides of holes to allow the bolt head to make full contact with the washer without tension.
  - 25. High-strength cap screws for attaching arms to standards must comply with ASTM A 325, A 325M, or A 449, and the mechanical requirements in ASTM A 325 or A 325M after galvanizing. Cap screws must be galvanized as specified in Section 75-1.05, "Galvanizing." Coat threads of cap screws with a colored lubricant, clean and dry to the touch. Lubricant color must contrast the zinc-coating color on the cap screw so the presence of the lubricant is visually obvious. Lubricant must be insoluble in water or the fastener components must be shipped to the job site in a sealed container.
  - 26. Bolted connection attaching signal or luminaire arm to pole must be considered slip critical. Galvanized faying surfaces of plates on luminaire, signal arm, and pole must be roughened by hand using a wire brush before assembly and must comply with requirements for Class C surface conditions for slip-critical connections in "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts," a specification approved by the Research Council on Structural Connections (RCSC). Paint for faying surfaces must be as specified in the RCSC specification for Class B coating.
  - 27. The Engineer will randomly take samples of fastener components from each production lot and submit to the Transportation Laboratory with test reports as specified in ASTM fastener specifications for QA testing and evaluation. The Engineer will determine sample sizes for each fastener component.

Change in mast arm configuration is allowed as long as the mounting height and stability are maintained.

Before manufacturing, details must be adjusted to ensure that cap screw heads can be turned using conventional installation tools. During manufacturing process, to avoid interference with the cap screw heads, the position of the luminaire arm on the arm plate must be properly located.

Configure mast arm as a smooth curving arm.

Push button post, pedestrian barricade, and guard post must comply with ASTM A 53.

Assemble and tighten slip base when pole is on the ground. Threads of heavy hex nuts for each slip-base bolt must be coated with additional lubricant that is clean and dry to the touch. Tighten high strength slip-base bolts to within  $\pm 10$  foot-pounds of the following:

### Slip-Base Bolt-Tightening Requirements

| Standard Type | Torque<br>(foot-pounds) |
|---------------|-------------------------|
| 15-SB         | 150                     |
| 30            | 150                     |
| 31            | 200                     |
| 36-20A        | 165                     |

Hole in shaft of existing standard, due to removal of equipment or mast arms, must be sealed by fastening a galvanized steel disk to cover the hole. Fasten using a single central galvanized steel fastener. Seal edges of disk and hole with polysulfide or polyurethane sealing compound of Type S, Grade NS, Class 25, and Use O, as specified in ASTM C 920.

If existing standard is ordered to be relocated or reused, remove large dents, straighten shafts, and replace parts that are in poor condition. You must furnish anchor bolts or bars and nuts required for relocating or reusing standard. Repair and replacement work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

New nuts, bolts, cap screws, and washers must be provided if:

1. Standard or mast arm is relocated
2. Used standard or mast arm is State furnished

If the standard has a slip base, a new keeper plate must be provided.

## 86-2.05 CONDUIT

Run conductors in conduit except for overhead and where conductors are run inside poles.

You may use a larger size conduit than specified as long as you use it for the entire length between outlets. Do not use reducing coupling.

New conduit must not pass through existing foundations for standards.

### 86-2.05A Material

Conduit and conduit fitting must be UL or NRTL listed and comply with the following:

#### Conduit and Conduit Fitting Requirements

|        |   |
|--------|---|
| Type 1 | Hot-dip galvanized rigid steel conduit and conduit couplings must comply with UL 6 and ANSI C80.1. Zinc coating testing must comply with copper sulfate test requirements in UL 6. Conduit couplings for rigid steel conduit must be electrogalvanized.   |
| Type 2 | Hot-dip galvanized rigid steel conduit must comply with requirements for Type 1 conduit and be coated with polyvinyl chloride (PVC) or polyethylene. Exterior thermoplastic coating must have a minimum thickness of 35 mils. Internal coating must have a minimum thickness of 2 mils. Coated conduit must comply with UL 6; NEMA RN 1; or NRTL PVC-001. |
| Type 3 | Rigid nonmetallic PVC conduit must comply with UL 651.<br>Type A extruded rigid PVC conduit and extruded rigid HDPE conduit must comply with UL 651A.<br>Coilable, smooth-wall, continuous length HDPE conduits must comply with UL 651B.<br>Install at underground locations only.   |
| Type 4 | Waterproof flexible metal conduit must consist of conduit with a waterproof non-metallic sunlight-resistant jacket over an inner flexible metal core. Type 4 conduit must be UL listed for use as the grounding conductor.  |
| Type 5 | Intermediate steel conduit and conduit couplings must comply with UL 1242 and ANSI C80.6. Zinc coating testing must comply with copper sulfate test requirements in UL 1242. Conduit couplings for intermediate rigid steel conduit must be electrogalvanized. Type 5 conduit must only be used if specified.   |

Bonding bushings to be installed on metal conduit must be insulated and either galvanized or zinc alloy type. Fittings for steel conduit and for watertight flexible metal conduit must be UL listed at UL 514B.



### 86-2.05B Use

Install Type 1 conduit on all exposed surfaces and at the following locations:

1. In concrete structures
2. Between a structure and nearest pull box

Exposed conduit installed on painted structure must be painted the same color as the structure.

Change or extend existing conduit runs using the same material. Install pull box if an underground conduit changes from the metallic type to Type 3.

Minimum trade size of conduit must be:

1. 1-1/2 inches from electrolier to adjacent pull box
2. 1 inch from pedestrian push button post to adjacent pull box
3. 2 inches from signal standard to adjacent pull box
4. 3 inches from controller cabinet to adjacent pull box
5. 2 inches from overhead sign to adjacent pull box
6. 2 inches from service equipment enclosure to adjacent pull box
7. 1-1/2 inches if unspecified

Two conduits must be installed between controller cabinet and adjacent pull box.

### 86-2.05C Installation

Whether shop or field cut, ream ends of conduit to remove burrs and rough edges. Make cuts square and true. Slip joints and running threads are not allowed for coupling conduit. If a standard coupling cannot be used for coupling metal type conduit, use a threaded union coupling that is UL or NRTL listed. Tighten couplings for metal conduit to maintain a good electrical connection through conduit run.

Cut Type 3 conduit with tools that will not deform the conduit. Use solvent weld for connections.

Cut Type 2 conduit with pipe cutters; do not use hacksaws. Coated conduit must be threaded with standard conduit-threading dies. Tighten conduit into couplings or fittings using strap wrenches or approved groove-joint pliers.

Protect shop-cut threads from corrosion as follows:

#### Shop-Cut Thread Protection

|   |            |
|---|------------|
| Steel conduit and conduit couplings                         | ANSI C80.1 |
| Electrical intermediate metal conduit and conduit couplings | ANSI C80.6 |

Paint conduits as specified in Section 91, "Paint." Apply 2 coats of approved unthinned zinc-rich primer of organic vehicle type. Do not use aerosol cans. Paint the following parts of conduits:

1. All exposed threads
2. Field-cut threads before installing conduit couplings to steel conduit
3. Damaged surfaces on metal conduit

Do not remove shop-installed conduit couplings.

Damaged Type 2 conduit or conduit coupling must be wrapped with at least 1 layer of 2 inch wide, 20 mil minimum thickness PVC tape, as specified in ASTM D 1000, with a minimum tape overlap of 1/2 inch. Before applying the tape, conduit or fitting must be cleaned and painted with 1 coat of rubber-resin based adhesive as recommended by the tape manufacturer. You may repair damaged spots in the thermoplastic coating by painting over with a brushing type compound supplied by the conduit manufacturer instead of the tape wrap.

The ends of Types 1, 2, or 5 conduit must be threaded and capped with standard pipe caps until wiring is started. The ends of Types 3 and 4 conduit must be capped until wiring is started. If caps are removed, replace with conduit bushings. Fit insulated bonding bushings on the end of metal conduit ending in pull box or foundation. Bell or end bushings for Type 3 conduit must be non-metallic type.

Conduit bends, except factory bends, must have a radius of not less than 6 times the inside diameter of the conduit. If factory bends are not used, bend the conduit without crimping or flattening using the longest radius practicable. Bend conduits as follows:

#### **Conduit-Bending Requirements**

|        |  |
|--------|--|
| Type 1 | By methods recommended by the conduit manufacturer and with equipment approved for the purpose.  |
| Type 2 | Use standard bending tool designed for use on thermoplastic coated conduit. Conduit must be free of burrs and pits.                    |
| Type 3 | By methods recommended by the conduit manufacturer and with equipment approved for the purpose. Do not expose conduit to direct flame. |
| Type 4 | --   |
| Type 5 | By methods recommended by the conduit manufacturer and with equipment approved for the purpose.  |

Install pull tape in conduit that is to receive future conductors. The pull tape must be a flat woven lubricated soft-fiber polyester tape with a minimum tensile strength of 1,800 pounds and have printed sequential measurement markings every 3 feet. At least 2 feet of pull tape must be doubled back into the conduit at each end.

Existing underground conduit to be incorporated into a new system must be cleaned with a mandrel or cylindrical wire brush and blown out with compressed air.

Install conduit to a depth of not less than 30 inches below finished grade, except in sidewalk and curbed paved median areas, where it must be at least 18 inches below grade. You may lay conduit on existing pavement within new curbed median.

Conduit coupling must be a minimum of 6 inches from face of foundation.

Place a minimum of 2 inches of sand bedding in the trench before installing Type 2 or Type 3 conduit. Place a minimum of 4 inches of same material over conduit before placing additional backfill material.

Obtain approval from the Engineer before disturbing pavement. If obstruction is encountered, obtain approval from Engineer to cut small holes in the pavement to locate or remove obstruction. If jacking or drilling method is used, keep jacking or drilling pit 2 feet away from edge of pavement. Pavement must not be weakened or subgrade softened from excess water use.

Conduit used for drilling or jacking must be removed; install new conduit for completed work. If a hole larger than the conduit is pre-drilled and you install conduit by hand or by method recommended by the conduit manufacturer with equipment approved for purpose, you may install Type 2 or Type 3 conduit under pavement.

If trenching in pavement method is specified, conduit installation under pavement that is not a freeway lane or freeway to freeway connector ramp, must comply with the following:

1. Use Type 3 conduit. Place conduit under pavement in a trench approximately 2 inches wider than the outside diameter of conduit, but not exceeding 6 inches in width. Trench depth must not exceed the greater of 12 inches or conduit trade size plus 10 inches, except that at pull boxes the trench may be hand dug to required depth. The top of the installed conduit must be a minimum of 9 inches below finished grade.
2. Trenching installation must be completed before placing final pavement layer.
3. Cut pavement to be removed with a rock cutting excavator. Minimize shatter outside the removal area.
4. Place conduit in bottom of trench and backfill with minor concrete as specified in Section 90-10, "Minor Concrete.". Minor concrete must contain a minimum of 590 pounds of cementitious material per cubic yard. If the trench is in asphalt concrete pavement and pavement overlay is not placed, backfill the top 0.10 foot of trench with minor HMA.
5. Before spreading HMA, apply tack coat as specified in Section 39, "Hot Mix Asphalt."
6. Backfill trenches, except for the top 0.10 foot, by the end of each day. The top 0.10 foot must be filled within 3 days after trenching.

Conduit installed beneath railroad tracks must be:

1. Type 1 or 2
2. 1-1/2-inch minimum diameter
3. Placed a minimum depth of 42 inches below bottom of the rail

If jacking or drilling method is used, construct jacking pit to a minimum of 13 feet from the centerline of track at the near side of jacking pit. Cover jacking pit with substantial planking if left overnight.

Conduit ending in standard or pedestal must not extend more than 3 inches vertically above the foundation and must be sloped toward the handhole opening. Conduit entering through the side of non-metallic pull box must end inside the box within 2 inches of the wall and 2 inches above the bottom and be sloped toward the top of box to facilitate pulling of conductors. Conduit entering through the bottom of a pull box must end 2 inches above the bottom and be located near the end walls to leave the major portion of the box clear. At outlet, conduit must enter from the direction of the run.

Underground conduit runs, including under sidewalks, that are adjacent to gasoline service stations or other underground gasoline or diesel storage, piping, or pumps and that lead to a controller cabinet, circuit breaker panel, service, or enclosure where an arc may occur during normal operations must be sealed if the conduit is within the limits specified in the NEC for Class 1, Division 1. Use Type 1 or Type 2 conduit for these runs.

Conduit for future use in structures must be threaded and capped. Conduit leading to soffit, wall, or other lights or fixtures below pull box grade must be sealed and made watertight, except where conduit ends in a No. 9 or No. 9A pull box.

Support for conduit in or on wall or bridge superstructure must comply with the following:

1. Steel hangers, steel brackets, and other fittings must comply with Section 75-1.03, "Miscellaneous Bridge Metal."
2. Construct precast concrete conduit cradles using minor concrete and commercial quality welded wire fabric. Minor concrete must comply with Section 90-10, "Minor Concrete," and contain a minimum of 590 pounds of cementitious material per cubic yard.. The cradles must be moist cured for a minimum of 3 days. Bond precast concrete cradles to structure with epoxy adhesives specified in one of the following:
  - 2.1. Section 95-2.03, "Epoxy Resin Adhesive for Bonding New Concrete to Old Concrete"
  - 2.2. Section 95-2.04, "Rapid Set Epoxy Adhesive for Pavement Markers"
  - 2.3. Section 95-2.05, "Standard Set Epoxy Adhesive for Pavement Markers"
3. Use pipe sleeve or form opening for conduit through bridge superstructure concrete. Sleeve or opening through either prestressed member or conventionally reinforced precast member must be:
  - 3.1. Transverse to the member
  - 3.2. Through the web
  - 3.3. Not more than 3 inches maximum gross opening in concrete
4. Where conduits pass through the abutment concrete, wrap conduit with 2 layers of asphalt-felt building paper securely taped or wired in place. Fill space around conduit that runs through bridge abutment wall with mortar as specified in Section 51-1.135, "Mortar," except the proportion of cementitious material to sand must be 1 to 3. Fill the space around conduits that run through abutments after prestressing is completed.
5. Run surface-mounted conduit straight and true, horizontal or vertical on the wall, and parallel to wall on ceiling or other similar surfaces. Support conduit at a maximum of 5-foot intervals or closer where necessary to prevent vibration or unsightly deflection. The supports must include galvanized malleable iron conduit clamps and clamp backs secured with expansion anchorage devices as specified for concrete anchorage devices in Section 75-1.03, "Miscellaneous Bridge Metal." Threaded studs must be galvanized and be of the largest diameter that will pass through the mounting hole in conduit clamp.
6. Where pull boxes are placed in conduit runs, conduit must be fitted with threaded bushings and bonded.
7. Mark location of conduit end in structure, curb, or wall with a "Y" that is a minimum of 3 inches tall, directly above conduit.

#### **86-2.05D Expansion Fittings**

Install expansion fitting where the conduit crosses an expansion joint in structure. Each expansion fitting for metal conduit must include a copper bonding jumper having the ampacity specified in NEC.

Each expansion-deflection fitting for expansion joints of 1-1/2-inch movement rating must be watertight and include a molded neoprene sleeve, a bonding jumper, and 2 silicon bronze or zinc-plated iron hubs. Each fitting must allow a minimum of 3/4-inch expansion, contraction, and lateral deflection.

## **86-2.06 PULL BOXES**

### **86-2.06A (Blank)**

### **86-2.06B Cover Marking**

Marking must be clearly defined, uniform in depth, and parallel to either the long or short sides of cover.

Marking letters must be 1 inch to 3 inches high.

Before galvanizing steel or cast iron cover, apply marking by one of the following methods:

1. Use cast iron strip at least 1/4 inch thick with letters raised a minimum of 1/16 inch. Fasten strip to cover with 1/4 inch flathead stainless steel machine bolts and nuts. Peen bolts after tightening.
2. Use sheet steel strip at least 0.027-inch thick with letters raised a minimum of 1/16 inch. Fasten strip to cover by spot welding, tack welding, or brazing, with 1/4 inch stainless steel rivets or 1/4 inch roundhead stainless steel machine bolts and nuts. Peen bolts after tightening.
3. Bead weld the letters on cover so that letters are raised a minimum of 3/32 inch.

### **86-2.06C Installation and Use**

Space pull boxes no more than 200 feet apart. You may install additional pull boxes to facilitate the work.

You may use a larger standard size pull box than that shown on the plans or specified.

A pull box in ground or sidewalk area must be installed as follows:

1. Embed bottom of pull box in crushed rock.
2. Place a layer of roofing paper on the crushed rock.
3. Place mortar over the layer of roofing paper. Mortar must be 0.50 inch to 1 inch thick and sloped toward the drain hole.
4. Make a 1-inch drain hole in center of pull box through mortar and roofing paper.
5. Place mortar between pull box and pull box extension, and around conduits.

The top of the pull box must be flush with the surrounding grade or the top of an adjacent curb, except in unpaved areas where the pull box is not immediately adjacent to and protected by a concrete foundation, pole, or other protective construction. Place the pull box 1-1/4 inches above the surrounding grade. Where practical, place a pull box shown in the vicinity of curbs or adjacent to a standard on the side of the foundation facing away from traffic, unless otherwise directed. If a pull box is installed in a sidewalk area, adjust the depth of the pull box so that the top of the pull box is flush with the sidewalk.

Reconstruct the sump of an existing pull box if it is disturbed by your operations. Remove old grout and replace with new if the sump was grouted.

## **86-2.07 TRAFFIC PULL BOXES**

Comply with Sections 86-2.06B, "Cover Marking," and 86-2.06C, "Installation and Use."

Traffic pull box and cover must comply with ASTM C857, "Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures," for HS20-44 loading. You must be able to place the load anywhere on box and cover for 1 minute without causing cracks or permanent deformations.

Frame must be anchored to the box with 1/4" x 2-1/4" concrete anchors. Four concrete anchors must be included for No. 3-1/2(T) pull box; one placed in each corner. Six concrete anchors must be included for No. 5(T) and No. 6(T) pull boxes; one placed in each corner and one near the middle of each of the longer sides.

Nuts must be zinc plated carbon steel, vibration resistant, and have a wedge ramp at the root of the thread.

After installation of traffic pull box, install steel cover and keep bolted down when your activities are not in progress at the pull box. When steel cover is placed for final time, cover and Z bar frame must be cleaned of debris and tightened securely.

Steel cover must be countersunk approximately 1/4 inch to accommodate bolt head. When tightened, bolt head must not exceed more than 1/8 inch above the top of cover.

Concrete placed around and under traffic pull box must be minor concrete as specified in Section 90-10, "Minor Concrete."

## **86-2.08 CONDUCTORS AND CABLES**

Conductor must be copper wire that complies with ASTM B 3 and B 8.

Wire size must comply with the following:

### Wire Size Requirements

| Conductor usage                                  | Requirement                           |
|--|---------------------------------------|
| In loop detector lead-in cable                   | ASTM B 286                            |
| Everywhere except in loop detector lead-in cable | American Wire Gage (AWG) <sup>a</sup> |

<sup>a</sup>Except conductor diameter must not be less than 98 percent of specified AWG diameter.

Single conductor and cable, except detector lead-in cable, must have clear, distinctive, and permanent markings on the outer surface throughout its length. The markings must include the manufacturer's name or trademark, insulation type letter designation, conductor size, voltage, and temperature rating, and for cables, it must also include number of conductors.

### 86-2.08A Conductor Identification

Conductor insulation must be a solid color with a permanent stripe as specified below. The solid color must be homogeneous through the full depth of insulation. Identification stripe must be continuous throughout the length of conductor. For conductor sizes No. 2 and larger, the insulation may be black and the ends of the conductors must be tapered for a minimum length of 20 inches with electrical insulating tape of the required color.

### Conductor Identification

| Circuit                                | Signal Phase or Function                      | Identification                |                     |                           | Size |
|--|---|-------------------------------|---------------------|---------------------------|------|
|  |   | Insulation Color <sup>i</sup> |                     | Band Symbols <sup>f</sup> |      |
|  |   | Base                          | Stripe <sup>a</sup> |                           |      |
| Vehicle Signals <sup>a,b,d</sup>       | 2,6   | Red, Yel, Brn                 | Blk                 | 2,6                       | 14   |
|  | 4,8   | Red, Yel, Brn                 | Ora                 | 4,8                       | 14   |
|  | 1,5   | Red, Yel, Brn                 | None                | 1,5                       | 14   |
|  | 3,7   | Red, Yel, Brn                 | Pur                 | 3,7                       | 14   |
|  | Ramp Meter 1                                  | Red, Yel, Brn                 | None                | NBR                       | 14   |
|  | Ramp Meter 2                                  | Red, Yel, Brn                 | Blk                 | NBR                       | 14   |
| Pedestrian Signals <sup>d</sup>        | 2p,6p   | Red, Brn                      | Blk                 | 2p,6p                     | 14   |
|  | 4p,8p   | Red, Brn                      | Ora                 | 4p,8p                     | 14   |
|  | 1p,5p   | Red, Brn                      | None                | 1p,5p                     | 14   |
|  | 3p,7p   | Red, Brn                      | Pur                 | 3p,7p                     | 14   |
| Pedestrian Push Buttons <sup>d</sup>   | 2p,6p   | Blu                           | Blk                 | P-2,P-6                   | 14   |
|  | 4p,8p   | Blu                           | Ora                 | P-4,P-8                   | 14   |
|  | 1p,5p   | Blu                           | None                | P-1,P-5                   | 14   |
|  | 3p,7p   | Blu                           | Pur                 | P-3,P-7                   | 14   |
| Traffic Signal Controller Cabinet      | Ungrounded Circuit Conductor                  | Blk                           | None                | CON-1                     | 6    |
|  | Grounded Circuit Conductor                    | Wht                           | None                | CON-2                     | 6    |
| Highway Lighting Pull Box to Luminaire | Ungrounded-Line 1                             | Blk                           | None                | NBR                       | 14   |
|  | Ungrounded-Line 2                             | Red                           | None                | NBR                       | 14   |
|  | Grounded                                      | Wht                           | None                | NBR                       | 14   |
| Multiple Highway Lighting              | Ungrounded-Line 1                             | Blk                           | None                | ML1                       | 10   |
|  | Ungrounded-Line 2                             | Red                           | None                | ML2                       | 10   |
| Lighting Control                       | Ungrounded to PEU                             | Blk                           | None                | C1                        | 14   |
|  | Switching leg from PEU unit or SM transformer | Red                           | None                | C2                        | 14   |

|                               |  |                  |      |                     |    |
|-------------------------------|--|------------------|------|---------------------|----|
| Service                       | Ungrounded-Line 1 (Signals)            | Blk              | None | NBR <sup>c</sup>    | 6  |
|                               | Ungrounded-Line 2 (Lighting)           | Red <sup>h</sup> | None | NBR <sup>c</sup>    | 8  |
| Sign Lighting                 | Ungrounded-Line 1                      | Blk              | None | SL-1                | 10 |
|                               | Ungrounded-Line 2                      | Red              | None | SL-2                | 10 |
| Flashing Beacons <sup>g</sup> | Ungrounded between Flasher and Beacons | Red or Yel       | None | F-Loc. <sup>c</sup> | 14 |
| Grounded and Common           | Pedestrian Push Buttons                | Wht              | Blk  | NBR                 | 14 |
|                               | Signals and Multiple Lighting          | Wht              | None | NBR                 | 10 |
|                               | Flashing Beacons and Sign Lighting     | Wht              | None | NBR                 | 12 |
|                               | Lighting Control                       | Wht              | None | C-3                 | 14 |
|                               | Multiple Service                       | Wht              | None | NBR                 | 14 |
| Railroad Preemption           |  | Blk              | None | R                   | 14 |
| Spares                        |  | Blk              | None | NBR                 | 14 |

NBR = No Band Required PEU=Photoelectric unit

<sup>a</sup>On overlaps, insulation is striped for 1st phase in designation. e.g., phase (2+3) conductor is striped as for phase 2.

<sup>b</sup>Band for overlap and special phases as required.

<sup>c</sup>Flashing beacons having separate service do not require banding.

<sup>d</sup>These requirements do not apply to signal cable.

<sup>e</sup>"S" if circuit is switched on line side of service equipment by utility.

<sup>f</sup>Band conductors in each pull box and near ends of termination points. On signal light circuits, a single band may be placed around 2 or 3 ungrounded conductors comprising a phase.

<sup>g</sup>Ungrounded conductors between service switch and flasher mechanism must be black and banded.

<sup>h</sup>Black acceptable for size No. 2 and larger. Tape ends for 20 inches with indicated color.

<sup>i</sup>Color Code: Yel-Yellow, Brn-Brown, Blu-Blue, Blk-Black, Wht-White, Ora-Orange, Pur-Purple.

### 86-2.08B Multiple Circuit Conductors

Conductor for multiple circuit must be UL or NRTL listed and rated for 600 V(ac) operation. Insulation for No. 14 to No. 4 conductors must be one of the following:

1. Type TW PVC as specified in ASTM D 2219
2. Type THW PVC
3. Type USE, RHH, or RHW cross-linked polyethylene

Minimum insulation thickness must comply with the following:

| Insulation Thickness |                  |                             |
|----------------------|------------------|-----------------------------|
| Insulation Type      | Conductor Size   | Insulation Thickness (mils) |
| USE, RHH, or RHW     | No. 14 to No. 10 | 39                          |
|                      | No. 8 to No. 2   | 51                          |
| THW or TW            | No. 14 to No. 10 | 27                          |
|                      | No. 8            | 40                          |
|                      | No. 6 to No. 2   | 54                          |

Insulation for No. 2 and larger conductor must be one of the types listed above or Type THWN.

Conductor for wiring wall and soffit luminaire must be stranded copper with insulation rated for use at temperatures up to 125 °C.

### 86-2.08C Signal Cable

Signal cable, except for the 28-conductor type, must:

1. Not be spliced

2. Be marked in each pull box with the signal standard information it is connecting to

Signal cable must comply with the following:

1. Cable jacket must be:
  - 1.1. Black polyethylene with an inner polyester binder sheath
  - 1.2. Rated for 600 V(ac) and 75 °C
2. Filler material, if used, must be polyethylene material.
3. Conductor must be solid copper with Type THWN insulation as specified in Section 86-2.08, "Conductors and Cables," and ASTM B 286. The minimum thickness of Type THWN insulation must be 12 mils for conductor sizes No. 14 to No. 12 and 16 mils for conductor size No. 10. The minimum thickness of nylon jacket must be 4 mils.

#### Conductor Signal Cable Requirements

| Cable Type <sup>a</sup> | Conductor Quantity and Type | Cable Jacket Thickness (mils) |         | Maximum Nominal Outside Diameter (inch) | Conductor Color Code   | Remarks  |
|-------------------------|-----------------------------|-------------------------------|---------|---|--|--|
|                         |                             | Average                       | Minimum |   |  |  |
| 3CSC                    | 3 - No. 14                  | 44                            | 36      | 0.40                                    | blue/black, blue/orange, white/black stripe  | Use for pedestrian push buttons and spare  |
| 5CSC                    | 5 - No. 14                  | 44                            | 36      | 0.50                                    | red, yellow, brown, black, white   |  |
| 9CSC                    | 8 - No. 14<br>1 - No. 12    | 60                            | 48      | 0.65                                    | No. 12 - white<br>No. 14 - red, yellow, brown, black, and red/black, yellow/black, brown/black, white/black stripe |  |
| 12CSC                   | 11 - No. 14<br>1 - No. 12   | 60                            | 48      | 0.80                                    | No. 12 - white<br>No. 14 - see "12CSC Color Code and Functional Connection" table                                  | Use for vehicle signals, pedestrian signals, spares, and signal common   |
| 28CSC                   | 27 - No. 14<br>1 - No. 10   | 80                            | 64      | 0.90                                    | No. 10 - white<br>No. 14 - see "28CSC Color Code and Functional Connection" table                                  | Keep signal commons in each cable separate except at the signal controller. Label each cable as "C1" or "C2" in pull box. Use "C1" for signal phases 1, 2, 3, and 4. Use "C2" for phases 5, 6, 7, and 8. |

<sup>a</sup>Conductor signal cable description starts with the number of conductors, followed by "CSC". (e.g., a signal cable with 3 conductors is labeled "3CSC".)

### 12CSC Color Code and Functional Connection

| Color Code          | Termination                                    | Phase         |
|---------------------|--|---------------|
| Red                 | Vehicle signal red                             | 2, 4, 6, or 8 |
| Yellow              | Vehicle signal yellow                          | 2, 4, 6, or 8 |
| Brown               | Vehicle signal green                           | 2, 4, 6, or 8 |
| Red/black stripe    | Vehicle signal red                             | 1, 3, 5, or 7 |
| Yellow/black stripe | Vehicle signal yellow                          | 1, 3, 5, or 7 |
| Brown/black stripe  | Vehicle signal green                           | 1, 3, 5, or 7 |
| Black/red stripe    | Spare, or use as required for red or DONT WALK |               |
| Black/white stripe  | Spare, or use as required for yellow           |               |
| Black               | Spare, or use as required for green or WALK    |               |
| Red/white stripe    | Ped signal DONT WALK                           |               |
| Brown/white stripe  | Ped signal WALK                                |               |

### 28CSC Color Code and Functional Connection

| Color Code             | Termination            | Phase          |
|------------------------|------------------------|----------------|
| Red/black stripe       | Vehicle signal red     | 2 or 6         |
| Yellow/black stripe    | Vehicle signal yellow  | 2 or 6         |
| Brown/black stripe     | Vehicle signal green   | 2 or 6         |
| Red/orange stripe      | Vehicle signal red     | 4 or 8         |
| Yellow/orange stripe   | Vehicle signal yellow  | 4 or 8         |
| Brown/orange stripe    | Vehicle signal green   | 4 or 8         |
| Red/silver stripe      | Vehicle signal red     | 1 or 5         |
| Yellow/silver stripe   | Vehicle signal yellow  | 1 or 5         |
| Brown/silver stripe    | Vehicle signal green   | 1 or 5         |
| Red/purple stripe      | Vehicle signal red     | 3 or 7         |
| Yellow/purple stripe   | Vehicle signal yellow  | 3 or 7         |
| Brown/purple stripe    | Vehicle signal green   | 3 or 7         |
| Red/2 black stripes    | Ped signal DONT WALK   | 2 or 6         |
| Brown/2 black stripes  | Ped signal WALK        | 2 or 6         |
| Red/2 orange stripes   | Ped signal DONT WALK   | 4 or 8         |
| Brown/2 orange stripes | Ped signal WALK        | 4 or 8         |
| Red/2 silver stripes   | Overlap A, C red       | OLA, OLC       |
| Brown/2 silver stripes | Overlap A, C green     | OLA, OLC       |
| Red/2 purple stripes   | Overlap B, D red       | OLB, OLD       |
| Brown/2 purple stripes | Overlap B, D green     | OLB, OLD       |
| Blue/black stripe      | Ped push button        | 2 or 6         |
| Blue/orange stripe     | Ped push button        | 4 or 8         |
| Blue/silver stripe     | Overlap A, C yellow    | OLA(y), OLC(y) |
| Blue/purple stripe     | Overlap B, D yellow    | OLB(y), OLD(y) |
| White/black stripe     | Ped push button common |                |
| Black/red stripe       | Railroad preemption    |                |
| Black                  | Spare                  |                |

#### 86-2.08D Signal Interconnect Cable (SIC)

Signal interconnect cable must be a 3-pair or 6-pair type with stranded tinned copper No. 20 conductors. Each conductor insulation must be 13 mils minimum nominal thickness, color-coded, polypropylene material. Conductors must be in twisted pairs. Color coding distinguishes each pair. Each pair must be wrapped with an aluminum polyester shield and must have a No. 22 or larger stranded tinned copper drain wire inside the shielded pair.

Cable jacket must be black, high density polyethylene, rated for a minimum of 300 V(ac) and 60 °C, and must have a minimum nominal wall thickness of 40 mils. Cable jacket or moisture-resistant tape directly under the outer jacket must be marked as specified in Section 86-2.08.

You must have a minimum of 6 feet of slack at each controller cabinet. Splicing is allowed only if shown on the plans.

Insulate conductor splice with heat-shrink tubing and overlap at least 0.6 inch. Cover overall cable splice with heat-shrink tubing and overlap the cable jacket at least 1-1/2 inch.



## 86-2.09 WIRING

Run conductors in conduit, except for overhead and temporary installations and where conductors are run inside poles.

Solder by hot iron, pouring, or dipping method, connectors and terminal lugs for conductor sizes No. 8 and smaller. Do not perform open-flame soldering.

### 86-2.09A Circuitry

Do not run traffic signal indication conductors to a terminal block on a standard unless connected to a mounted signal head.

Use only 1 conductor to connect to each terminal of a pedestrian push button.

The common for pedestrian push button circuit must be separate from traffic signal circuit grounded conductor.

### 86-2.09B Installation

Use a UL- or NRTL-listed inert lubricant for placing conductors in conduit.

Pull conductors into conduit by hand using pull tape specified in Section 86-2.05C, "Installation." Do not use winches or other power-actuated pulling equipment.

If adding new conductors or removing existing conductors, remove all conductors, clean conduit as specified in Section 86-2.05C, "Installation," and pull all conductors in conduit as 1 unit.

If traffic signal conductors are run in lighting standard containing street lighting conductors from a different service point, you must encase the traffic signal conductors or the lighting conductors with a flexible or rigid metal conduit for a length until the 2 types of conductors are no longer in the same raceway.

If less than 10 feet above grade, enclose temporary conductors in flexible or rigid metal conduit.

Leave slack for each conductor as follows:

**Conductor Slack Requirements**

| Location                     | Slack<br>(feet) |
|------------------------------|-----------------|
| Signal standard              | 1               |
| Lighting standard            | 1               |
| Signal and lighting standard | 1               |
| Pull box                     | 3               |
| Splice                       | 3               |
| Standards with slip base     | 0               |

After conductors are installed, seal ends of conduits with an approved sealing compound.

To form a watertight seal, tape ends of spare conductors and conductors ending in pull boxes.

Conductors and cables inside fixture or cabinet must be neatly arranged and tied together by function with self-clinching nylon cable ties or enclosed in plastic tubing or raceway.

Identify conductors for signal overlap phase as specified for vehicle signals in the table titled "Conductor Identification."

Permanently identify conductors by function. Place identification on each conductor, or each group of conductors forming a signal phase, at each pull box and near the end of conductors.

Label, tag, or band conductors by mechanical methods. Identification must not move along the conductors.

### 86-2.09C Connectors and Terminals

Connectors and terminals must be UL- or NRTL-listed crimp type. Use manufacturer-recommended tool for connectors and terminals to join conductors. Comply with MIL-T-7928.

Terminate stranded conductors smaller than No. 14 in crimp style terminal lugs.

### 86-2.09D Splicing and Terminations

Splices are allowed for:

1. Grounded conductors in pull box.
2. Pedestrian push button conductors in pull box.
3. Conductors in pull box adjacent to each electrolier or luminaire.
4. Ungrounded traffic signal conductors in pull box, if traffic signals are modified.

5. Ungrounded traffic signal conductors to a terminal compartment or signal head on a standard with conductors of the same phase in the pull box adjacent to the standard.
6. Ungrounded lighting circuit conductors in pull box, if lighting circuits are modified.

#### **86-2.09E Splice Insulation**

Splice must function under continuous submersion in water.

Multi-conductor cable must be spliced and insulated to form a watertight joint and to prevent moisture absorption by the cable.

Low-voltage tape must be:

1. UL or NRTL listed
2. Self-fusing, oil and flame-resistant, synthetic rubber
3. PVC, pressure-sensitive adhesive of 6 mils minimum thickness

Insulating pad must be a combination of an 80-mils thick electrical grade PVC laminate and a 120-mils thick butyl splicing compound with removable liner.

Heat-shrink tubing must comply with the following:

1. Be medium or heavy wall thickness, irradiated polyolefin tubing with an adhesive mastic inner wall.
2. Before contraction, minimum wall thickness must be 40 mils.
3. Heating must be as recommended by the manufacturer. Do not perform open-flame heating.
4. When heated, the inner wall must melt and fill crevices and interstices of the covered object and the outer wall must shrink to form a waterproof insulation.
5. After contraction, each end of the heat-shrink tubing or the open end of end cap of heat-shrink tubing must overlap the conductor insulation at least 1-1/2 inches. Coat ends and seams with electrical insulation coating.
6. Comply with requirements for extruded insulated tubing at 600 V(ac) in UL Standard 468D and ANSI C119.1, and the following requirements:

**Heat-Shrink Tubing Requirements**

|                       |  |
|-----------------------|--|
| Shrinkage Ratio       | 33 percent, maximum, of supplied diameter when heated to 125 °C and allowed to cool to 25 °C |
| Dielectric Strength   | 350 kV per inch, minimum   |
| Resistivity           | 25 <sup>13</sup> Ω per inch, minimum   |
| Tensile Strength      | 2,000 psi, minimum   |
| Operating Temperature | -40 °C to 90 °C (135 °C in emergency)  |
| Water Absorption      | 0.5 percent, maximum   |

7. If 3 or more conductors are to be enclosed in 1 splice, place mastic around each conductor before placing inside tubing. Use mastic type recommended by heat-shrink tubing manufacturer.

You may use "Method B" as an alternative method for splice insulation. Use at least 2 thicknesses of electrical insulating pad. Apply pad to splice as recommended by manufacturer.

#### **86-2.095 FUSED SPLICE CONNECTORS**

Install a fused disconnect splice connector in each ungrounded conductor, between the line and the ballast, in the pull box adjacent to each luminaire. Connector must be accessible in the pull box.

For 240 and 480 V(ac) circuits, each connector must simultaneously disconnect both ungrounded conductors. Connector must not have exposed metal parts, except for the head of stainless steel assembly screw. Recess head of stainless steel assembly screw a minimum of 1/32 inch below top of plastic boss that surrounds the head.

Splice connector must protect fuse from water or weather damage. Contact between fuse and fuseholder must be spring loaded. Splice connector terminals must be:

1. Rigidly crimped, using a tool recommended by manufacturer of fused splice connector, onto ungrounded conductors
2. Insulated
3. Watertight

Fuses must be standard midget ferrule type, with "Non-Time-Delay" feature, and 13/32" x 1-1/2".

#### **86-2.10 BONDING AND GROUNDING**

Secure all metallic components, mechanically and electrically, to form a continuous system that is effectively grounded.

Bonding jumper must be copper wire or copper braid of the same cross sectional area as a No. 8 or larger to match the load. Equipment grounding conductors must be color coded as specified in NEC or be bare.

Attach bonding jumper to standard as follows:

| <b>Bonding Jumper Attachment</b>                      |   |
|---|---|
| <b>Standard type</b>                                  | <b>Requirements</b>   |
| Standard with handhole and traffic pull box lid cover | Use UL-listed lug and 3/16-inch diameter or larger brass or bronze bolt. Run jumper to conduit or bonding wire in adjacent pull box. Grounding jumper must be visible after the standard is installed and mortar pad is placed on foundation. |
| Standard without handhole                             | Use UL-listed ground clamp on each anchor bolt.   |
| Slip-base standard                                    | Use UL-listed ground clamp on each anchor bolt or attach UL-listed lug to bottom slip-base plate with 3/16-inch diameter or larger brass or bronze bolt.  |

Ground one side of secondary circuit of step-down transformer.

Ground metal conduit, service equipment, and grounded conductor at service point as specified by NEC and service utility, except grounding electrode conductor must be No. 6 or larger.

Equipment bonding and grounding conductors are required in conduit. Run a No. 8 minimum bare copper wire continuously in conduit system. The bonding wire must be sized as specified in the NEC.

Ground electrode must be:

1. 1 piece
2. 10-foot minimum length of one of the following:
  - 2.1. Galvanized steel rod or pipe not less than 3/4 inch in diameter
  - 2.2. Copper clad steel rod not less than 5/8 inch in diameter
3. Installed as specified in NEC
4. Bonded to service equipment using one of the following:
  - 4.1. Ground clamp
  - 4.2. Exothermic weld
  - 4.3. No. 6 or larger copper conductor

On wood pole, metallic equipment mounted less than 8 feet above ground surface must be grounded.

Bond metallic conduit in non-metallic pull box using bonding bushing or bonding jumper.

Bond metallic conduit in metal pull box using bonding bushings and bonding jumpers connected to bonding wire running in the conduit system.

#### **86-2.11 SERVICE**

Electrical service installation and materials must comply with service utility requirements.

If service equipment is to be installed on utility-owned pole, you must furnish and install conduit, conductors, and other necessary material to complete service installation. Service utility will decide riser and equipment position.

Install service equipment early on to allow service utility to schedule its work before project completion.

Furnish each service with a circuit breaker that simultaneously disconnects all ungrounded service entrance conductors.

Circuit breakers must:

1. Be quick-break on either automatic or manual operation.
2. Have operating mechanism that is enclosed and trip-free from operating handle on overload.

3. Be trip indicating.
4. Have frame size plainly marked.
5. Have trip rating clearly marked on operating handle.
6. Have overload tripping of breakers not influenced by ambient temperature range of -18 °C to 50 °C.
7. Be internal trip type.
8. Be UL or NRTL listed and comply with UL 489 or equal.
9. Have minimum interrupting capacity of 10,000 A, rms, if used as service disconnect.

Service equipment enclosure must be a NEMA 3R enclosure with dead-front panel and a hasp with a 7/16-inch hole for a padlock. Enclosure must be field marked as specified in the NEC to warn qualified persons of potential electric arc flash hazards.

Service equipment enclosure, except Types II and III, must be galvanized or have a factory-applied rust-resistant prime coat and finish coat.

Types II and III service equipment enclosures must be manufactured from one of the following:

1. Galvanized sheet steel
2. Sheet steel plated with zinc or cadmium after manufacturing
3. Aluminum

Manufacture service equipment enclosure as specified in Section 86-3.04A, "Cabinet Construction." Overlapping exterior seams and doors must comply with requirements for NEMA 3R enclosures in the NEMA Enclosure Standards.

If an alternative design is proposed for Type II or III service equipment enclosure, submit plans and shop drawings to the Engineer for approval before manufacturing.

Except for falsework lighting and power for your activities, when you submit a written request, the Engineer will arrange:

1. With the service utility to complete service connections for permanent installations and the Department will pay all costs and fees required by the service utility. Submit request at least 15 days before service connections are required.
2. For furnishing electrical energy. Energy used before contract completion will be charged to you, except cost of energy used for public benefit as ordered by the Engineer will be paid by the Department or local authorities.

Full compensation for furnishing and installing State-owned or permanent service poles, service equipment, conduit, conductors, and pull boxes, including equipment, conduit, and conductors placed on utility-owned poles, is included in the contract item of electrical work involved and no additional compensation will be allowed therefor.

If the service point is indeterminate and is shown on the plans as "approximate location" or "service point not yet established," the labor and materials required for making the connection between the service point, when established, and the nearest pull box shown on the plans will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

## **86-2.12 WOOD POLES**

Wood poles must comply with the following:

1. Class 5 or larger as specified in ANSI O 5.1
2. Less than 180-degree twist in grain over the full length
3. 4-inch or less sweep
4. Beveled top
5. Placed in ground at least 6 feet
6. Length must be:
  - 6.1. 25 feet for service pole
  - 6.2. 35 feet for other

After each pole is set in ground, backfill space around pole with selected earth or sand, free of rocks and other deleterious material, placed in 4-inch thick layers. Moisten each layer and thoroughly compact.

Manufacture mast arm from standard pipe, free from burrs. Each mast arm must have an insulated wire inlet and wood pole mounting brackets for mast arm and tie-rod cross arm. Manufacture tie rod from structural steel and pipe.

Mount mast arm for luminaire to provide a 34-foot mounting height for a 200 W high pressure sodium luminaire and 40-foot mounting height for 310 W high pressure sodium luminaire. Traffic signals and flashing beacons on mast arm must provide a minimum vertical clearance of 17 feet from bottom of equipment to pavement.

After manufacturing, pressure-treat pole as specified in Section 58, "Preservative Treatment of Lumber, Timber and Piling," and AWP A Use Category System: UC4B, Commodity Specification D.

If specified, treat pole with waterborne wood preservative.

### **86-2.13 LIGHTING AND SIGN ILLUMINATION CONTROL**

Enclosure for the circuit breaker for lighting and sign illumination control must:

1. Be NEMA 3R
2. Be galvanized, cadmium plated, or powder-coated
3. Include dead front panel and a hasp with a 7/16 inch diameter hole for padlock

### **86-2.14 TESTING**

#### **86-2.14A Materials Testing**

Deliver material and equipment to be tested to either the Transportation Laboratory or a testing location ordered by the Engineer.

Allow 30 days for acceptance testing from the time material or equipment is delivered to test site. You must pay for all shipping, handling, and related transportation costs associated with testing. If equipment is rejected, you must allow 30 days for retesting. Retesting period starts when corrected equipment is delivered to test site. You must pay for all retesting costs. Delays resulting from submittal of non-compliant materials do not relieve you from executing the contract within the allotted time.

If equipment submitted for testing does not comply with specifications, remove the equipment within 5 business days after notification that the equipment is rejected. If equipment is not removed within that period, it may be shipped to you at your expense.

When testing is complete, you will be notified. You must pick up the equipment at the test site and deliver it to the job site.

Testing and quality control procedures for all other traffic signal controller assemblies must comply with NEMA TS Standards for Traffic Control Systems.

#### **86-2.14B Field Testing**

Before starting functional testing, perform the following tests in the presence of the Engineer:

##### **86-2.14B(1) Continuity**

Test each circuit for continuity.

##### **86-2.14B(2) Ground**

Test each circuit for grounds.

##### **86-2.14B(3) Insulation Resistance**

Perform insulation resistance test at 500 V(dc) on each circuit between the circuit and a ground. Insulation resistance must be 10 M $\Omega$  minimum on all circuits, except for inductive loop detector circuits that must have an insulation resistance value at least 100 M $\Omega$ .

#### **86-2.14C Functional Testing**

Test periods must comply with Section 86-1.07, "Scheduling of Work."

Acceptance of new or modified traffic signal will be made only after all traffic signal circuits have been thoroughly tested.

Perform functional test to show that each part of the system functions as specified.

Functional test for each new or modified system must include at least 5 business days of continuous, satisfactory operation. If unsatisfactory performance of the system occurs, the condition must be corrected and the system retested until the 5 business days of continuous, satisfactory operation is obtained.

Except for new or modified parts of existing lighting circuit and sign illumination system, the State or local agency will maintain the system during test period and pay the electrical energy cost. Except for electrical energy, you must pay the cost of necessary maintenance performed by the State or local agency on new circuits or on the portions of existing circuits modified under the contract.

Shutdown of electrical system caused by traffic from a power interruption or from unsatisfactory performance of State-furnished materials does not constitute discontinuity of the functional test.

#### **86-2.15 GALVANIZING**

Galvanize as specified in Section 75-1.05, "Galvanizing." Cabinet material may be galvanized before manufacturing as specified in ASTM A 653/653M, Coating Designation G 90.

Steel pipe standard and pipe mast arm must be hot-dip galvanized after manufacturing and must comply with Section 75-1.05, "Galvanizing." . Remove spikes from galvanized surfaces.

A minimum of 10 inches of upper end of anchor bolts, anchor bars or studs, and nuts and washers must be galvanized as specified in Section 75-1.05, "Galvanizing."

After galvanizing, bolt threads must accept galvanized standard nuts without requiring tools or causing removal of protective coatings.

Galvanizing existing materials in an electrical installation will not be required.

#### **86-2.16 PAINTING**

Paint electrical equipment and material as specified in Section 59, "Painting," and the following:

1. Use paint material specified in Section 91, "Paint."
2. Factory or shop cleaning methods for metals are acceptable if equal to the methods specified.
3. Instead of temperature and seasonal restrictions for painting as specified in Section 59, "Painting," paint may be applied to equipment and materials for electrical installations if ordered by the Engineer.
4. Ungalvanized ferrous surface to be painted must be cleaned before applying prime coat. Blast cleaning is not required.
5. If an approved prime coat is applied by manufacturer, and in good condition, the 1st primer application is not required.
6. Existing equipment to be painted in the field, including State-furnished equipment, must be washed with a stiff bristle brush using a solution of water containing 2 tablespoons of heavy duty detergent powder per gallon. After rinsing, surface must be wire-brushed with a coarse, cup-shaped, power-driven brush to remove badly bonded paint, rust, scale, corrosion, grease, or dirt. Dust or residue remaining after wire brushing must be removed before priming.
7. Do not paint galvanized metal guard post, galvanized equipment, State-furnished controller cabinet, and wood poles for traffic signal or flashing beacon.
8. New galvanized metal surface to be painted in the field must be cleaned as specified for existing equipment before applying the prime coat. Do not wire brush new galvanized surface.
9. After erection, examine exterior surface for damaged primer, clean, and spot coat with primer.
10. Paint Types II and III steel service equipment enclosures with a polymeric or an enamel coating system matching Color No. 14672, light green, of Federal Standard 595B. Coating must be commercially smooth and free of flow lines, paint washout, streaks, blisters, and other defects that would impair serviceability or detract from general appearance. Coating must comply with the following:
  - 10.1. Coating hardness - Finish must have pencil lead hardness of HB, minimum, using an Eagle Turquoise pencil.
  - 10.2. Salt spray resistance - Undercutting coating system's film must not exceed 1/8-inch average, from lines scored diagonally and deep enough to expose the base metal, after 336 hours of exposure in a salt spray cabinet complying with ASTM B 117.
  - 10.3. Adherence - Must not have coating loss when tested as specified in California Test 645. Perform testing by applying coating to 4" x 8" x 0.024" test specimens of the same material as the cabinet, using the same application method.
11. Finish interior of metal signal visor, louver, and front face of back plates with 2 applications of lusterless black exterior grade latex paint formulated for application to properly prepared metal surface. Good condition factory finish will be acceptable.
12. Finish metal signal section, signal head mounting, brackets and fittings, outside of visor, pedestrian push button housing, pedestrian signal section and visor, and back face of back plate with 2 applications of

- lusterless black or dark olive green exterior grade latex paint formulated for application to properly prepared metal surface. Match dark olive green color to Color Chip No. 68 filed at the Transportation Laboratory.
13. Prepare and finish conduit and conduit fitting above ground the same as adjacent standard or post.
  14. Relocated, reset or modified equipment previously finished as specified in this section, except for previously-finished galvanized standard with traffic signal yellow enamel, must be given a spot finishing application on newly primed areas and 1 finishing application over the entire surface. If signal face or mounting brackets are required to be painted under this section, all signal faces and mounting brackets on the same mounting must be repainted.
  15. Small rusted or repaired areas of relocated or reset galvanized equipment must be cleaned and painted as specified in Section 75-1.05, "Galvanizing," for repairing damaged galvanized surfaces.
  16. Stencil equipment number neatly on the standard or adjacent structure. Obtain number from the Engineer.
  17. Perform painting neatly. The Engineer reserves the right to require use of brushes if the work performed by paint spraying machine is unsatisfactory.

### **86-3 CONTROLLER ASSEMBLIES**

#### **86-3.01 CONTROLLER ASSEMBLIES**

A controller assembly houses a complete mechanism for controlling the operation of traffic signals or other systems.

Model 170 and Model 2070, specified as a Model 170/2070 controller assembly, includes a Model 170, 170E or 2070 controller unit, a wired cabinet, and all auxiliary equipment required to control the system.

#### **86-3.02 (BLANK)**

#### **86-3.03 (BLANK)**

#### **86-3.04 CONTROLLER CABINETS**

Controller cabinets for controller assemblies other than Model 170/2070 must comply with the following:

##### **86-3.04A Cabinet Construction**

Cabinet must be rainproof and the top crowned 1/2 inch or slanted toward the back to prevent standing water. Cabinet and door must be manufactured from one of the following:

1. 0.073-inch minimum thickness cold-rolled steel with continuously-welded exterior seams
2. 0.073-inch minimum thickness stainless steel with overlapping exterior seams complying with Type 4 enclosures of the NEMA Enclosure Standards
3. 0.125-inch minimum thickness aluminum with continuously-welded exterior seams

Exterior welds must be ground smooth and edges filed to a radius of at least 0.03 inch.

Cabinet manufactured from cold-rolled steel must comply with Section 86-2.16, "Painting," and the following:

1. Cabinet manufactured from cold-rolled steel must be finished with a polymeric or an enamel coating system conforming to Color No. 14672 of Federal Standard 595B.
2. Cabinet must not have coating loss when 2 test specimens, 4" x 8", of the same material and coating as the cabinet are tested. Two 9-inch-diagonal scratches exposing bare metal will be made on a specimen. Soak specimen in demineralized water for 192 hours. Tightly affix a 1-inch wide strip of masking tape to the surface and remove with one quick motion. Specimen showing evidence of blistering, softening, or peeling of paint or coating from the base metal will be rejected. Testing must comply with California Test 645, except passing 180 Degree Bend Test is not required.
3. Metal must be prepared by the 3-step, iron phosphate conversion coating bonderizing technique.
4. Inside walls, doors, and ceiling of the housing must be the same as the outside finish.

Cabinet manufactured from stainless steel must comply with the following:

1. Use annealed or quarter-hard stainless steel that complies with ASTM A 666 for Type 304, Grades A or B.
2. Use gas tungsten arc welding (GTAW) process with bare stainless steel welding electrodes. Electrodes must comply with AWS A5.9 for ER308 chromium-nickel bare arc welding electrodes.

3. Procedures, welder, and welding operator must comply with requirements and practices recommended in AWS C5.5.
4. Ground or brush exposed, exterior surfaces of stainless steel cabinet to a 25 to 50-microinch finish using iron-free abrasives or stainless steel brushes.
5. After grinding or brushing, cabinet must not show rust discoloration when:
  - 5.1. Exposed for 48 hours in a salt spray cabinet as specified in ASTM B 117
  - 5.2. Exposed 24 hours in a tap water spray cabinet with the water temperature between 38 °C and 45 °C
6. After the test, cabinet showing rust discoloration anywhere on its surface will be rejected. Rejected cabinets may be cleaned, passivated, and resubmitted for testing.

Cabinet manufactured from aluminum sheet must comply with ASTM B 209 or B 209M for 5052-H32 aluminum sheet, and the following:

1. Use gas metal arc welding (GMAW) process with bare aluminum welding electrodes. Electrodes must comply with AWS A5.10 for ER5356 aluminum alloy bare welding electrodes.
2. Procedures, welder, and welding operator for welding must comply with requirements in AWS B3.0, "Welding Procedure and Performance Qualification," and to practices recommended in AWS C5.6.
3. Surface finish of each aluminum cabinet must comply with MIL-A-8625 for a Type II, Class I coating, except anodic coating must have a minimum thickness of 0.0007 inch and a minimum coating weight of 0.001 ounce per square inch. The anodic coating must be sealed in a 5 percent aqueous solution of nickel acetate, pH 5.0 to 6.5, for 15 minutes at 97 °C. Before applying anodic coating, clean and etch cabinets using the steps below:
  - 3.1. Clean by immersing into inhibited alkaline cleaner, Oakite 61A, Diversey 909, or equal, 6 to 8 ounces per gallon at 71 °C for 5 minutes.
  - 3.2. Rinse in cold water.
  - 3.3. Etch in solution of 1-1/2 ounce of sodium fluoride and 4 to 6 ounces of sodium hydroxide per gallon of distilled water at 60 °C to 65 °C for 5 minutes.
  - 3.4. Rinse in cold water.
  - 3.5. Immerse in 50 percent by volume nitric acid solution at room temperature for 2 minutes.
  - 3.6. Rinse in cold water.

Cabinet must have:

1. Single front door with:
  - 1.1. 44-inch maximum door width.
  - 1.2. Lock, when closed and latched, that is locked.
  - 1.3. Police panel mounted on door, equipped with a keyed lock and 2 police keys. Each police key must have a shaft at least 1-3/4 inch in length.
2. Dust-tight gasketing on all door openings, permanently bonded to the metal. Mating surface of the gasketing must be covered with silicone lubricant to prevent sticking.
3. Handle that:
  - 3.1. Allows padlocking in closed position
  - 3.2. Has a minimum length of 7 inches
  - 3.3. Has a 5/8-inch, minimum, steel shank
  - 3.4. Is manufactured of cast aluminum, or zinc-plated or cadmium-plated steel
4. Cabinet door frame with:
  - 4.1. Latching mechanism that:
    - 4.1.1. Holds tension on and forms a firm seal between door gasketing and frame.
    - 4.1.2. Is a 3-point cabinet latch with nylon rollers that have a minimum diameter of 3/4 inch and equipped with ball bearings.



- 4.1.3. Has a center catch and a pushrod made of zinc-plated or cadmium-plated steel. Pushrod must be at least 1/4" x 3/4" and turned edgewise at outer supports. Cadmium plating must comply with MIL-QQ-416. Zinc plating must comply with MIL-QQ-325.

4.2. Hinging that:

- 4.2.1. Has 3-bolt butt hinges, each having a stainless steel fixed pin. Hinges must be stainless steel or may be aluminum for aluminum cabinet.
- 4.2.2. Is bolted or welded to the cabinet. Hinge pins and bolts must not be accessible when door is closed.
- 4.2.3. Has a catch to hold the door open at 90 degrees and 180 degrees,  $\pm 10$  degrees, if a door is larger than 22 inches in width or 6 square feet in area. Catch must be at least 3/8-inch diameter, stainless steel plated rod capable of holding door open at 90 degrees in a 60 mph wind at an angle perpendicular to the plane of the door.

5. Lock that:

- 5.1. Is solid brass, 6-pin tumbler, rim type
- 5.2. Has rectangular, spring-loaded bolts
- 5.3. Is left hand and rigidly mounted with stainless steel machine screws approximately 2 inches apart
- 5.4. Extends 1/8 to 3/8 inch beyond the outside surface of door

6. 2 keys that are removable in the locked and unlocked positions.

Submit alternative design details for review and approval before manufacturing cabinet.

Use metal shelves or brackets that will support controller unit and auxiliary equipment.

Machine screws and bolts must not protrude outside the cabinet wall.

#### **86-3.04B Cabinet Ventilation**

Each controller cabinet must have:

- 1. 8 screened, 1/2-inch diameter or larger, raintight vent holes, in lower side or bottom of cabinet. You may use louvered vents with a permanent metal mesh or 4-ply woven polypropylene air filter held firmly in place, instead.
- 2. Electric fan with ball or roller bearings and capacity of at least 100 cubic feet per minute. Fan must be thermostatically controlled and manually adjustable to turn on between 32 °C and 65 °C with a differential of not more than 6 °C between automatic turn on and turn off. Fan circuit must be fused at 125 percent of ampacity of installed fan motor.

Fan and cabinet vent holes must be positioned to direct bulk of airflow over controller unit or through ventilating holes of controller unit.

#### **86-3.04C Cabinet Wiring**

Conductors used in controller cabinet wiring must:

- 1. Be neatly arranged and laced, or enclosed in plastic tubing or raceway.
- 2. End with properly sized captive or spring-spade terminal or be soldered to a through-panel solder lug on the back side of the terminal block. Apply crimp-style connector with proper tool to prevent opening of handle until crimp is completed.

Controller cabinet must have an equipment grounding conductor bus that is grounded to the cabinet and connected to metal conduit system or other approved ground with a No. 8, or larger, grounding conductor.

With all cabinet equipment in place and connected, resistance between grounded conductor terminal bus and equipment grounding conductor bus must be 50 M $\Omega$ , minimum, when measured with an applied voltage of 150 V(dc).

If direct current is to be grounded, connect to equipment ground only.

Use two or more terminal blocks for field connection. Install field terminal within 22 inches from front of cabinet and orient for screwdriver operation. Terminal must be a minimum of 5 inches above foundation.

No more than 3 conductors per terminal are allowed. Two flat metal jumpers, straight or U shaped, may be placed under terminal screw. At least 2 full threads of terminal screws must be fully engaged when screw is tightened. Live parts must not extend beyond the barrier.

### **86-3.05 CABINET ACCESSORIES**

#### **86-3.05A Labels**

Include permanently printed, engraved, or silk-screened label for equipment and removable items of equipment.

Labeling must match cabinet wiring diagram. Label for shelf-mounted equipment must be on shelf face below item. Label for wall-mounted equipment must be below item.

#### **86-3.05B Convenience Receptacle**

Mount convenience receptacle in a readily accessible location inside the cabinet.

Convenience receptacle must be a duplex, 3-prong, NEMA 5-15R grounding type outlet that complies with UL Standard 943.

#### **86-3.05C Surge Arrestor**

Surge arrestor must reduce effects of power line voltage transients and have ratings as follows:

| <b>Surge Arrestor Requirements</b>          |           |
|---|-----------|
| Recurrent peak voltage                      | 184 V(ac) |
| Energy rating, maximum                      | 20 J      |
| Power dissipation, average                  | 0.85 W    |
| Peak current for pulses less than 7 $\mu$ s | 1,250 A   |

Standby current must be 1 mA or less for 120 V(ac), 60 Hz sinusoidal input.

#### **86-3.05D Terminal Blocks**

Terminal block must be rated 600 V(ac), minimum, and have nickel-, silver-, or cadmium-plated brass binder head screw terminal.

Heavy duty terminal block must be rated at 20 A and have 12 position with No. 10 x 5/16-inch nickel-plated brass binder head screws and nickel-plated brass inserts. Each position must have 2 screw-type terminals. Terminal block must be barrier type with shorting bars in each of the 12 positions, and must have integral type marking strips.

Light duty terminal block must be rated at 5 A and have 12 positions with No. 6 x 1/8 inch binder head screws. Each position must have 1 screw-type terminal.

### **86-3.06 COMPONENTS**

#### **86-3.06A Toggle Switches**

Toggle switch must:

1. Have poles as required
2. Be rated at 200 percent of circuit current for circuits of 10 A or less and 125 percent of circuit current for circuits over 10 A

#### **86-3.06B Cartridge Fuses**

Install cartridge fuse in panel-mounted fuseholder. Fuse type and rating must be as recommended by the fuse manufacturer for protecting the load.

#### **86-3.06C Circuit Breakers**

Circuit breaker must comply with Section 86-2.11, "Service," except breaker must have a minimum interrupting capacity of 5,000 A, rms.

#### **86-3.06D Connectors**

Use connector designed to interconnect various parts of circuit together and constructed for the application involved. Design connector for positive connection of circuit and easy insertion and removal of mating contacts. Connector must be permanently keyed to prevent improper connection of circuit.

Connector, or device plugging into connector, must have positive connection to prevent a circuit from breaking due to vibration, a pull on connecting cable, or similar disruptive force.

## **86-4 TRAFFIC SIGNAL FACES AND FITTINGS**

### **86-4.01 VEHICLE SIGNAL FACES**

Each vehicle signal face must:

1. Be adjustable and allow for 360-degree rotation about vertical axis
2. Comply with ITE publication ST-017B, "Vehicle Traffic Control Signal Heads"
3. Comply with California Test 604, except for arrow and "X" faces
4. Have 3 sections arranged vertically: red at top, yellow at center, and green at bottom
5. Be of the same manufacturer and material, if more than 1 is installed at an intersection, except for programmed visibility type
6. Be sealed with neoprene gasket at top opening
7. Be LED modules

#### **86-4.01A Signal Sections**

Each signal section must comply with the following:

1. Maximum height must be 10-1/4 inches for an 8-inch section and 14-3/4 inches for a 12-inch section.
2. Housing must:
  - 2.1. Be either die-cast or permanent mold-cast aluminum, or if specified, be structural plastic.
  - 2.2. Comply with ITE publication ST-017B if die-cast or permanent mold-cast aluminum is used.
  - 2.3. Have a 1-piece, hinged, square-shaped door designed to allow access for relamping without the use of tools. Door must be secured to hold the door closed during loading tests. Module or lens must be watertight and mounted in the door.
3. Hinge pins, door latching devices, and other exposed hardware must be Type 304 or 305 stainless steel. Interior screws and fittings must be stainless steel, or steel with a corrosion resistant plating or coating.
4. Opening must be placed on top and bottom to receive 1-1/2-inch pipe. The 8-inch and 12-inch sections of an individual manufacturer must be capable of joining to form a signal face in any combination. This interchangeability is not required between metal and plastic sections.
5. Gaskets must be made of a material that is not affected if installed in a section with metal or plastic housing that is continuously operated for 336 hours.

Structural failure is described as follows:

**Signal Section Structural Failure**

| Signal Section Type | Requirements        | Description of Structural Failure   |
|---------------------|---------------------|---|
| Metal               | California Test 666 | Fracture within housing assembly or deflection of more than half the lens diameter of signal section during wind load test  |
| Plastic             | California Test 605 | Fracture within housing assembly or deflection of more than 10 degrees in either the vertical or horizontal plane after wind load has been removed from front of signal face, or deflection of more than 6 degrees in either the vertical or horizontal plane after wind load has been removed from back of signal face |

#### **86-4.01A(1) Metal Signal Sections**

Each metal signal section must have a metal visor. Metal signal faces requiring backplates must have metal backplates.

#### **86-4.01A(2) Plastic Signal Sections**

Housing must be molded in 1 piece, or fabricated from 2 or more pieces and joined into a single piece. Plastic must have ultraviolet stability, be unaffected by lamp heat, and be self-extinguishing. Housing and door must be colored throughout and be black, matching Color No. 17038, 27038, or 37038 of Federal Standard 595B.

Each face section must be joined to adjacent section by one of the following:

1. Minimum of 3 machine screws for 8-inch sections and 4 machine screws for 12-inch sections, installed through holes near front and back of housing. Each screw must be a No. 10 and have a nut, flat washer, and lock washer.
2. Two machine screws, each with a nut, flat washer, and lock washer, installed through holes near the front of the housing, and a fastening through the 1-1/2-inch pipe opening. Fastening must have 2 large flat washers to distribute the load around the pipe opening and 3 carriage bolts, each with a nut and lock washer. Minimum screw size must be No. 10. Minimum carriage bolt size must be 1/4 inch.

Supporting section of each signal face supported only at top or bottom must have reinforcement.

Reinforcement plate must be either sheet aluminum, galvanized steel, or cast aluminum. Each plate must be a minimum of 0.11-inch thick and have a hole concentric with 1-1/2-inch pipe-mounting hole in the housing. Place reinforcement plate as follows:

**Reinforcement Plate Placement**

| Type of Reinforcement Plate | Placement                     |
|-----------------------------|-------------------------------|
| Sheet aluminum              | Inside and outside of housing |
| Galvanized steel            | Inside of housing             |
| Cast aluminum               | Outside of housing            |

Reinforcement plates placed outside of the housing must be finished to match signal housing color and be designed to allow proper serrated coupling between signal face and mounting hardware. Minimum of 3 No. 10 machine screws must be installed through holes in each plate and matching holes in the housing. Each screw must have a round or binder head, a nut, and lock washer.

If signal face is supported by a Type MAS side attachment slip-fitter inserted between 2 sections, place spacers between the 2 sections. Vertical dimension of spacers must allow proper seating of serrations between the slip-fitter and the 2 sections. In addition to the fastening through the large openings in housing, the 2 sections must join with at least 2 machine screws through holes near the front of housing and the spacers, and through matching holes in a reinforcing plate installed in housing. Machine screws must be No. 10 minimum size. Spacers must be made of same material as signal housing.

If reinforcing webs are used to connect back of housing to top, bottom, and sides, reinforcing plates are not required.

Holes for machine screws must be either cast or drilled during signal section manufacturing. Surround each hole with a 1/8-inch minimum width boss to allow contact between signal sections about axis of hole.

Each plastic signal section must have a plastic or metal visor. Plastic signal faces requiring backplates must have plastic backplates.

Serrated nylon washer must be inserted between each plastic signal section and metal mounting assembly. Each washer must be between 3/16- and 1/4-inch thick. Serrations must match those on signal section and mounting assembly.

#### **86-4.01B Electrical Components**

Conductors must be connected to a terminal block mounted inside, at the back of housing. Terminal block must have enough screw type terminals or NEMA type tab connectors to end all field and module or lamp conductors independently. Permanently identify terminal with field conductors attached or color code conductors to facilitate field wiring.

#### **86-4.01C Visors**

Include removable visor with each signal section. Comply with ITE publication ST-017B. Visors are classified by lens enclosure as full circle, tunnel or cap. Bottom opens for tunnel type and both, bottom and lower sides open for cap type. Visors must be tunnel type.

Visor must have a downward tilt between 3 and 7 degrees with a length of:

1. 9-1/2-inch minimum for nominal 12-inch round lenses
2. 7 inch for nominal 8-inch round lenses

Metal visor must be formed from 0.050-inch, minimum thickness, aluminum alloy sheet.

Plastic visor must be either formed from sheet plastic or assembled from one or more injection, rotational, or blow-molded plastic sections. Material must be of a black homogeneous color with lusterless finish. Sections must be joined using thermal, chemical, or ultrasonic bonding, or with aluminum rivets and washers permanently colored to match visor.

Secure each visor to its door and prevent removal or permanent deformation when wind load specified in California Test 605 for plastic visors or 666 for metal visors is applied to its side for 24 hours.

If directional louvers are used, fit louvers snugly into full-circular signal visors. Outside cylinder must be constructed of 0.030-inch nominal thickness, or thicker, sheet steel and vanes must be constructed of 0.016-inch nominal thickness, or thicker, sheet steel, or the cylinder and vanes must be constructed of 5052-H32 aluminum alloy of equal thickness.

#### **86-4.02 (BLANK)**

#### **86-4.03 (BLANK)**

#### **86-4.04 BACKPLATES**

Background light must not be visible between backplate and signal face or between sections.

Plastic backplates must be either formed from sheet plastic or assembled from extruded, molded, or cast sections. Sections must be factory joined using one of the following:

1. Appropriate solvent cement
2. Aluminum rivets and washers painted or permanently colored to match backplate
3. No. 10 machine screws with washers, lock washers, and nuts, painted to match backplate

Backplate material must be of black homogeneous color with a lusterless finish. Secure each plastic backplate to the plastic signal face in a manner that prevents its removal or permanent deformation when the wind-load test is applied to either the front or back of signal face. Permanent deformation of any portion of backplate must not exceed 5 degrees forward or backward after wind loading is applied for 24 hours.

If plastic backplate requires field assembly, join with at least 4 No. 10 machine screws at each field-assembled joint. Each machine screw must have an integral or captive flat washer, a hexagonal head slotted for a standard screwdriver, and either a locking nut or a nut and lockwasher. Machine screws, nuts, and washers must be stainless steel or steel with a zinc or black-oxide finish.

If a metal backplate has 2 or more sections, fasten sections with rivets or aluminum bolts peened after assembly to avoid loosening.

Instead of the screws shown on the plans, you may use self-threading No. 10 steel screws to fasten plastic backplates to plastic signal face. Each screw must have an integral or captive flat washer, a hexagonal head slotted for a standard screwdriver, and is stainless steel or steel with a zinc or black-oxide finish.

#### **86-4.05 PROGRAMMED VISIBILITY VEHICLE SIGNAL FACES**

Programmed visibility signal face and its installation must comply with Section 86-4.01, "Vehicle Signal Faces," Section 86-4.04, "Backplates," and Section 86-4.08, "Signal Mounting Assemblies."

Each programmed visibility signal section must:

1. Have a nominal 12-inch diameter circular or arrow indication
2. Comply with ITE publication ST-017B for color and arrow configuration
3. Have a cap visor
4. Have an adjustable connection that provides incremental tilting from 0 to 10 degrees above or below horizontal while maintaining a common vertical axis through couplers and mountings

Terminal connection must allow external adjustment about the mounting axis in 5-degree increments.

Signal must be mountable with ordinary tools and capable of servicing without tools. Preset adjustment at 4 degrees below horizontal.

Visibility of each programmed visibility signal face must be capable of adjustment or programming, within the face. When programmed, each signal face's indication must be visible only in those areas or lanes to be controlled, except that during dusk and darkness a faint glow to each side is allowed.

You must program the head as recommended by the manufacturer.

#### **86-4.06 PEDESTRIAN SIGNAL FACES**

Message symbols for pedestrian signal faces must be white "WALKING PERSON" and Portland orange "UPRAISED HAND." Comply with ITE Standards: "Pedestrian Traffic Control Signal Indications" and California MUTCD. Each symbol's height must be at least 10 inches and width must be at least 6-1/2 inches.

Luminance of "UPRAISED HAND" symbol must be 1,100 foot-lamberts, minimum, and luminance of "WALKING PERSON" symbol must be 1,550 foot-lamberts, minimum, when tested as specified in California Test 606.

Uniformity ratio of an illuminated symbol must not exceed 4 to 1 between the highest luminance area and the lowest luminance area.

Luminance difference between a nonilluminated symbol and the background around the symbol must be less than 30 percent when viewed with the visor and front screen in place and at a low sun angle.

Each housing, including front screen, must have maximum overall dimensions of 18-1/2-inch width, 19-inch height, and 11-1/2-inch depth.

All new pedestrian signal faces installed at an intersection must be the same make and type.

##### **86-4.06A Type A**

Each Type A pedestrian signal face must include a housing, 1 LED pedestrian signal combo module and a front screen.

##### **86-4.06B Front Screen**

Front screen installation for each Type A signal must comply with one of the following:

1. Install, tilting downward, at an angle of  $15 \pm 2$  degrees out from the top, an aluminum honeycomb screen with 0.2-inch cells, 3/8-inch thick, or a plastic screen of 3/8-inch squares, 1/2-inch thick with wall thickness of 1/16-inch. Completely cover message plate. Include a clear front cover of 1/8-inch minimum thickness acrylic plastic sheet or 1/16-inch minimum thickness polycarbonate plastic. Hold screen and cover firmly in place with stainless steel or aluminum clips or stainless steel metal screws.
2. Install a 1-1/2-inch deep eggcrate or Z crate type screen of 1/32-inch nominal thickness polycarbonate. Mount screening in a frame constructed of 0.040-inch minimum thickness aluminum alloy or polycarbonate. Install screen parallel to face of message plate and hold in place with stainless steel screws.

The Department will test screens in a horizontal position with its edges supported. When a 3-inch diameter, 4-pound steel ball is dropped on the screen from a height of 4 feet above, the front screen must not fracture, separate at the welds, or compress more than 1/8-inch. When pedestrian housing is used to support front screen during test, remove message plate from pedestrian signal housing, so there is no back support for the screen.

Screen and frame must be one of the following:

1. Manufactured from aluminum anodized flat black
2. Finished with lusterless black exterior grade latex paint formulated for application to properly prepared metal surfaces
3. Manufactured from flat black plastic

##### **86-4.06C Housing**

Pedestrian signal housing must comply with Section 86-4.01A, "Signal Sections."

##### **86-4.06D Finish**

Paint exterior of each housing as specified in Section 86-2.16, "Painting."

##### **86-4.06E Control**

Pedestrian signals must be controllable by solid-state switching devices specified for traffic signal controller assemblies.

##### **86-4.06F Terminal Blocks**

Include light duty terminal block, as specified in Section 86-4.01B, "Electrical Components," with each pedestrian signal face.

## **86-4.07 (BLANK)**

### **86-4.08 SIGNAL MOUNTING ASSEMBLIES**

Signal mounting assembly must include:

1. 1-1/2-inch standard steel pipe or galvanized conduit
2. Pipe fitting made of ductile iron, galvanized steel, aluminum alloy Type AC-84B No. 380, or bronze
3. Mast arm and post top slip-fitters, and terminal compartments made of cast bronze or hot-dip galvanized ductile iron

After installation, clean and paint exposed threads of galvanized conduit brackets and bracket areas damaged by wrench or vise jaws. Use wire brush to clean and apply 2 coats of approved unthinned zinc-rich primer, organic vehicle type, as specified in Section 91, "Paint." Do not use aerosol can.

Fit each terminal compartment with a terminal block having a minimum of 12 positions, each with 2 screw-type terminals. Each terminal must accommodate at least five No. 14 conductors. Include a cover on compartment for ready access to terminal block. Terminal compartment used to bracket mount signals must be bolted securely to pole or standard.

Horizontal dimension of mounting assembly members between vertical centerline of terminal compartment or slip-fitter, and the vertical centerline of each signal face must not exceed 11 inches, except where required for proper signal face alignment or to allow programming of programmed visibility signal faces.

Mounting assembly members must be plumb or level, symmetrically arranged, and securely assembled.

Mounting assembly must be watertight, and free of sharp edges or protrusions that might damage conductor insulation. Include positive locking serrated fittings that, if mated with similar fittings on signal faces, will prevent faces from rotating.

Orient each mounting assembly to allow maximum horizontal clearance to adjacent roadway.

Use slip-fitter for post-top mounting of signals. Fit slip-fitter over a 4-1/2-inch outside diameter pipe or tapered standard end. Include cadmium-plated steel set screws. Include an integral terminal compartment for each slip-fitter used to post-top mount signals with brackets.

Do not install signal faces at an intersection until all other signal equipment, including complete controller assembly, is in place and ready for operation. You may mount signal faces if covered or not directed toward traffic.

### **86-4.09 FLASHING BEACONS**

Flashing beacon must include:

1. Single section traffic signal face with yellow or red LED module indications
2. Backplate
3. Tunnel visor
4. Flashing beacon control assembly

Beacon flasher unit must be independent of intersection flasher unit.

#### **86-4.09A Flashing Beacon Control Assembly**

##### **86-4.09A(1) Enclosure**

Enclosure must be:

1. NEMA 3R with a dead front panel and a hasp with a 7/16-inch hole for a padlock
2. Powder coated, hot-dip galvanized, or factory-applied rust resistant prime coat and finish coat

##### **86-4.09A(2) Circuit Breakers and Switches**

Circuit breakers must comply with Section 86-2.11, "Service."

Switch for manually operating sign lighting circuit must be a single-hole-mounting toggle type with a single pole and throw and rated at 12 A, 120 V(ac). Furnish switch with an indicating nameplate reading "Auto-Test."

##### **86-4.09A(3) Flasher**

Comply with Section 8, "Solid-State Flashers," of NEMA Standards publication No. TS 1.

Flasher must be a solid-state device with no contact points or moving parts.

Include 2 output circuits to allow alternate flashing of signal faces. Flasher must be able to carry a minimum of 10 A per circuit at 120 V(ac).

#### **86-4.09A(4) Wiring**

Conductors and wiring in the enclosure must comply with Section 86-2.09B(1), "Cabinet and Enclosure Installation."

#### **86-4.09A(5) Terminal Blocks**

Terminal blocks must be:

1. Rated 25 A, 600 V(ac)
2. Molded phenolic or nylon material
3. Barrier type with plated brass screw terminals and integral marking strips

### **86-5 DETECTORS**

#### **86-5.01 VEHICLE DETECTORS**

Sensor unit and isolator must comply with TEES.

##### **86-5.01A Inductive Loop Detectors**

#### **86-5.01A(1) General**

Inductive loop detector includes a completely installed loop or group of loops, in the roadway, lead-in cable, and a sensor unit, with power supply installed in a controller cabinet.

#### **86-5.01A(2) (Blank)**

#### **86-5.01A(3) Construction Materials**

Conductor for each inductive loop detector must be continuous, unspliced, and one of the following:

**Conductor Options for Inductive Loop Detector**

| Option           | Specifications  |
|------------------|---|
| Type 1 loop wire | Type RHW-USE neoprene-jacketed or Type USE cross-linked polyethylene insulated, No. 12, stranded copper wire with a 40 mils minimum thickness at any point.   |
| Type 2 loop wire | Type THWN or Type XHHW, No. 14, stranded copper wire in a plastic tubing. Plastic tubing must be polyethylene or vinyl, rated for use at 105 °C, and resistant to oil and gasoline. Outside diameter of tubing must be 0.27 inch maximum with a wall thickness of 0.028 inch minimum. |

Conductor for loop detector lead-in cable must be two No. 16, 19 x 29, stranded, tinned copper wires, comply with the calculated cross sectional area of ASTM B 286, Table 1, and be one of the following:

**Conductor Options for Loop Detector Lead-In Cable**

| Option               | Specifications  |
|----------------------|---|
| Type B lead-in cable | Insulated with 20 mils of high-density polyethylene. Conductors must be twisted together with at least 2 turns per foot and the twisted pair must be protected with a copper or aluminum polyester shield. A No. 20, minimum, copper drain wire must be connected to equipment ground within cabinet. Cable must have a high-density polyethylene or high-density polypropylene outer jacket with a nominal thickness of 32 mils. Include an amorphous interior moisture penetration barrier of nonhydroscopic polyethylene or polypropylene fillers. |
| Type C lead-in cable | Comply with International Municipal Signal Association (IMSA) Specification No. 50-2. A No. 20, minimum, copper drain wire must be connected to equipment ground within cabinet.  |



#### 86-5.01A(4) Installation Details

Install loop conductors without splices and end in nearest pull box. Seal open end of cable jacket or tubing similar to splicing requirements to prevent water from entering. Do not make final splices between loops and lead-in cable until loop operations under actual traffic conditions is approved.

Splice all loop conductors for each direction of travel for same phase of a traffic signal system, in same pull box, to a detector lead-in cable that runs from pull box adjacent to loop detector to a sensor unit mounted in controller cabinet.

End all loop conductors in a pull box or terminal strip in the cabinet.

Identify and band conductors for inductive loop installations. Band, in pairs, by lane, in the pull box adjacent to the loops and near the end of conductors in the cabinet. Bands must comply with Section 86-2.09, "Wiring."

If HMA surfacing is to be placed, install loop conductors before placing uppermost layer of HMA. Install conductors in compacted layer of HMA immediately below the uppermost layer. Install conductors as shown on the plans, except fill slot with sealant flush to the surface.

When cutting loops:

1. Residue from slot cutting activities must not be allowed to flow across shoulders or lanes occupied by public traffic and must be removed from the pavement surface before residue flows off. Dispose of residue from slot cutting activities under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way."
2. Surplus sealant must be removed from adjacent road surface without using solvents before setting.

Sealant for filling slots must comply with one of the following:

##### Elastomeric Sealant

Polyurethane material that will, within stated shelf life, cure only in the presence of moisture. Sealant must be suitable for use in both HMA and PCC.

The cured sealant must have the following performance characteristics:

**Performance Characteristics of Cured Sealant**

| Specification  | ASTM           | Requirement                                     |
|--|----------------|---|
| Hardness (indentation) at 25 °C and 50% relative humidity. (Type A, Model 1700 only)         | D 2240<br>Rex. | 65-85   |
| Tensile Strength:<br>Pulled at 508 mm per minute   | D 412<br>Die C | 3.45 MPa, min.                                  |
| Elongation:<br>Pulled at 508 mm per minute   | D 412<br>Die C | 400%, min.                                      |
| Flex at -40 °C:<br>0.6-mm free film bend (180°) over 13-mm mandrel                           | --             | No cracks                                       |
| Weathering Resistance:<br>Weatherometer 350 h, cured 7 days at 25 °C @ 50% relative humidity | D 822          | Slight chalking                                 |
| Salt Spray Resistance:<br>28 days at 38 °C with 5% NaCl, Die C & pulled at 508 mm per minute | B 117          | 3.45 MPa, min. tensile 400%,<br>min. elongation |
| Dielectric Constant over a temperature range of -30 °C to 50 °C                              | D 150          | Less than 25% change                            |

##### Asphaltic Emulsion Sealant

Comply with State Specification 8040-41A-15. Use for filling slots in HMA pavement that are a maximum of 5/8 inch in width. Do not use where the slope causes the material to run from the slot. Material must not be thinned beyond manufacturer's recommendations. Place material when air temperature is at least 7 °C.

##### Hot-Melt Rubberized Asphalt Sealant

Hot-melt rubberized asphalt must be:

1. In solid form at room temperature and fluid at application temperature of 190 °C to 205 °C. Fumes must be non-toxic.

2. Suitable for use in both HMA and PCC.
3. Melted in a jacketed, double-boiler type melting unit. Temperature of heat transfer medium must not exceed 245 °C.
4. Applied with a pressure feed applicator or pour pot, when the pavement surface temperature is greater than 4 °C.
5. Packaged in containers clearly marked "Detector Loop Sealant" and specifying manufacturer's batch and lot number.

The cured sealant must have the following performance characteristics:

| <b>Performance Characteristics of Cured Sealant</b>             |                 |                      |
|---|-----------------|----------------------|
| Specification   | ASTM            | Requirement          |
| Cone Penetration, 25 °C, 150 g, 5 s                             | D 5329, Sec. 6  | 3.5 mm, max          |
| Flow, 60 °C   | D 5329, Sec. 8  | 5 mm, max            |
| Resilience, 25 °C   | D 5329, Sec. 12 | 25%, min             |
| Softening Point   | D 36            | 82 °C, min           |
| Ductility, 25 °C, 50 mm/min                                     | D 113           | 300 mm, min          |
| Flash Point, COC, °C  | D 92            | 288 °C, min          |
| Viscosity, Brookfield Thermosel, No. 27 Spindle, 20 rpm, 190 °C | D 150           | Less than 25% change |

#### **86-5.01B Magnetic Detectors**

Cable from pull box, adjacent to magnetic detector sensing element, to the field terminals in the controller cabinet must be the type specified for inductive loop detectors.

#### **86-5.02 PEDESTRIAN PUSH BUTTON ASSEMBLIES**

Housing must be either die-cast or permanent mold-cast aluminum, or ultraviolet stabilized, self-extinguishing structural plastic, if specified. Plastic housing must be black matching Color No. 17038, 27038 or 37038 of Federal Standard 595B, and colored throughout. Assembly must be rainproof and shockproof in any weather condition.

Switch must be a single-pole, double-throw, switching unit, with screw type terminals, rated 15 A at 125 V(ac), and must have:

1. Plunger actuator and a U frame to allow recessed mounting in push button housing
2. Operating force of 3.5 pounds
3. 1/64-inch maximum pretravel
4. 7/32-inch minimum overtravel
5. 0.0004- to 0.002-inch differential travel
6. 2-inch minimum diameter actuator

Where pedestrian push button is attached to a pole, shape housing to fit the pole curvature and secure. Include saddles to make a neat fit if needed.

Where a pedestrian push button is mounted on top of a 2-1/2-inch diameter post, fit housing with a slip-fitter and use screws for securing rigidly to post.

Pedestrian push button signs must be porcelain enameled metal or structural plastic.

Install push button and sign on crosswalk side of pole.

Point arrows on push button signs in the same direction as the corresponding crosswalk.

Attach sign on Type B push button assembly.

For Type C pedestrian push button assembly, mount instruction sign on the same standard as the push button assembly, using 2 straps and saddle brackets. Straps and saddle brackets must be corrosion-resisting chromium nickel steel and comply with ASTM A 167, Type 302B. Theft-proof bolts must be stainless steel with a chromium content of at least 17 percent and a nickel content of at least 8 percent.

### **86-6 LIGHTING**

#### **86-6.01 HIGH PRESSURE SODIUM LUMINAIRES**

High pressure sodium luminaires must be the enclosed cutoff type.

Housing must be manufactured from aluminum. Painted or powder-coated housing must withstand a 1,000-hour salt spray test as specified in ASTM B 117.

Other metal parts must be corrosion resistant.

Each housing must include a slip-fitter that can be mounted on a 2-inch pipe tenon and can be adjusted 5 degrees from the axis of the tenon. Clamping brackets of slip-fitter must not bottom out on housing bosses when adjusted within the  $\pm 5$  degree range.

The slip-fitter mounting bracket must not permanently set in excess of 0.020-inch when the 3/8-inch diameter cap screw used for mounting is tightened to 10 foot-pounds.

Luminaire to be mounted horizontally on mast arm, when tested as specified in California Test 611, must be capable of withstanding cyclic loading for a minimum of 2 million cycles without failure of any luminaire parts as follows:

#### **Cyclic Loading**

| Plane                   | Internal Ballast | Minimum Peak Acceleration Level <sup>a</sup>                |
|-------------------------|------------------|---|
| Vertical                | Removed          | 3.0 G peak-to-peak sinusoidal loading (same as 1.5 G peak)  |
| Horizontal <sup>b</sup> | Installed        | 1.5 G peak-to-peak sinusoidal loading (same as 0.75 G peak) |
| Vertical                | Installed        | 1.0 G peak-to-peak sinusoidal loading (same as 0.5 G peak)  |

<sup>a</sup>G = Acceleration of gravity

<sup>b</sup>Perpendicular to direction of mast arm

If a photoelectric unit receptacle is included, a raintight shorting cap must be installed. If luminaire housing has a hole for the receptacle, hole must be permanently closed, covered, and sealed with weatherproof material.

Optical system must be in a sealed chamber and include:

1. Reflector shaped so that a minimum of light is reflected through the arc tube of the lamp. Reflector surface must be specular and protected by either an anodized finish or a silicate film on its specular surface.
2. Refractor or lens mounted in a door frame that is hinged to the housing and secured with a spring-loaded latch. Refractor must be made of glass or polycarbonate plastic. Lens must be made of heat- and impact-resistant glass.
3. Lamp socket that is a porcelain enclosed mogul-multiple type. Shell must include integral lamp grips to assure electrical contact under conditions of normal vibration. Socket must be mounted in the luminaire to allow presetting a variety of specified light distribution patterns. Socket must be rated for 1,500 W and 600 V(ac), and a 4 kV pulse.
4. Lamp.

Sealing must be provided by a gasket between the reflector and:

1. Refractor or lens
2. Lamp socket

Chamber must allow for filtered flow of air in and out of the chamber from lamp heat. Filtering must be accomplished by either a separate filter or a filtering gasket.

If components are mounted on a down-opening door, door must be hinged and secured to luminaire housing separately from refractor or flat lens frame. Door must be easily removable and replaceable, and secured to housing to prevent accidental opening when refractor or flat lens frame is opened.

Field wires connected to luminaire must terminate on a barrier-type terminal block secured to the housing. Terminal screws must be captive and equipped with wire grips for conductors up to No. 6. Each terminal positions must be clearly identified.

Minimum light distribution for each luminaire must meet the isolux diagrams.

Maximum brightness of each cutoff luminaire, with the lamp indicated, must be as follows:

#### Cutoff Type

| Lamp<br>ANSI Code No. | Lamp<br>Wattage | Maximum Brightness<br>foot-lamberts |
|-----------------------|-----------------|-------------------------------------|
| S55                   | 150             | 40                                  |
| S66                   | 200             | 40                                  |
| S50                   | 250             | 50                                  |
| S67                   | 310             | 60                                  |
| S51                   | 400             | 75                                  |

Brightness readings will be taken using a brightness meter with an acceptance angle of 1.5 degrees. When measured on the 90-degree and 270-degree lateral angle line, maximum brightness must not exceed above specified brightness when meter is located at a horizontal distance of 120 feet and a vertical distance of 7.5 feet between luminaire and meter, or at an angle of 3 degrees 35 minutes from the horizontal to the line between luminaire and meter. Measurements must be made from 90-degree line and 270-degree line, and averaged. Lamp used for each test must operate at wattage necessary to produce the following light output:

#### Light Output

| Lamp Wattage | Lumens |
|--------------|--------|
| 150          | 16,000 |
| 200          | 22,000 |
| 250          | 27,000 |
| 310          | 37,000 |
| 400          | 50,000 |

#### 86-6.01A High Pressure Sodium Lamp Ballasts

Each ballast must:

1. Operate the lamp for its rated characteristics and wattage
2. Continuously operate at ambient air temperatures from -20 °C to 25 °C without reduction in ballast life
3. Operate for at least 180 cycles of 12 hours on and 12 hours off, with the lamp circuit in an open or short-circuited condition and without measurable reduction in operating requirements
4. Have a design life of not less than 60,000 hours
5. Provide proper starting and operating waveforms, voltage, and current
6. Provide reliable lamp starting and operation at ambient temperature down to -20 °C for the rated life of lamp

Ballast must be tested as specified in ANSI C82.6-1980, "Methods of Measurement of High-Intensity-Discharge Lamp Ballasts."

Starting aids for ballast of a given lamp wattage must be interchangeable between ballasts of same wattage and manufacturer, without adjustment.

Each integral ballast must consist of separate components that can be easily replaced. An encapsulated starting aid will be counted as a single component. Each component must include screw terminals, NEMA tab connectors, or a single multi-circuit connector. Conductors and terminals must be identified.

Mount heat-generating component so as to use the portion of the luminaire it is mounted to as a heat sink. Place capacitor a maximum practicable distance from heat-generating components or thermally shield to limit the case temperature to 75 °C.

Transformer and inductor must be resin-impregnated for protection against moisture. Capacitors, except those in starting aids, must be metal cased and hermetically sealed.

The Department will test high-pressure sodium lamp ballast. High-pressure sodium lamp ballast must have a characteristic curve that will intersect both of the lamp-voltage limit lines between the wattage limit lines and remain between the wattage limit lines throughout the full range of lamp voltage. This requirement must be met at the rated input voltage of the ballast and at the lowest and highest rated input voltage of the ballast.

Throughout the lifetime of the lamp, ballast curve must fall within the specified limits of the lamp voltage and wattage.

Ballast for luminaires must be located in the luminaire housing.

#### 86-6.01A(1) Regulator Type Ballasts

Regulator type ballast must comply with the following:

1. For nominal input voltage and lamp voltage, ballast design center must not vary more than 7.5 percent from rated lamp wattage.
2. Ballast must be designed for a capacitance variance of  $\pm 6$  percent that will not cause more than  $\pm 8$  percent variation in lamp wattage regulation during rated lamp life.
3. Lamp current crest factor must not exceed 1.8 for input voltage variation of  $\pm 10$  percent at any lamp voltage during lamp life.

Regulator-type ballast must be one of the following:

#### **Regulator-Type Ballast**

| Ballast Type           | Power Factor  | Lamp Regulation   |
|------------------------|---|---|
| Lag-type <sup>a</sup>  | Not less than 90 percent throughout the life of lamp when ballast is operated at nominal line voltage with a nominally-rated reference lamp | Lamp wattage regulation spread does not vary by more than 18 percent for $\pm 10$ percent input voltage variation from nominal through life |
| Lead-type <sup>b</sup> | Not less than 90 percent throughout the life of lamp when ballast is operated at nominal line voltage with a nominally-rated reference lamp | Lamp wattage regulation spread does not vary by more than 30 percent for $\pm 10$ percent input voltage variation from nominal through life |

<sup>a</sup>Primary and secondary windings must be electrically isolated

<sup>b</sup>Constant wattage autoregulator (CWA)

#### **86-6.01A(2) Nonregulator Type Ballasts**

Each nonregulator type ballast must comply with the following:

1. For nominal input voltage and lamp voltage, ballast design center must not vary more than 7.5 percent from rated lamp wattage.
2. Lamp current crest factor must not exceed 1.8 for input voltage variation of  $\pm 5$  percent at any lamp voltage during lamp life.

#### **Nonregulator-Type Ballast**

| Ballast Type                      | Power Factor  | Lamp Regulation  |
|-----------------------------------|---|--|
| Autotransformer or High-Reactance | Not less than 90 percent throughout the life of lamp when ballast is operated at nominal line voltage with a nominally-rated reference lamp | Lamp wattage regulation spread does not vary by more than 25 percent for $\pm 5$ percent input voltage variation from nominal through life |

#### **86-6.01B High Pressure Sodium Lamps**

High pressure sodium lamps must comply with ANSI C 78.42, "High Pressure Sodium Lamps," when tested as specified in ANSI C 78.389, "American National Standard for Electric Lamps - High Intensity Discharge-Methods of Measuring Characteristics." High pressure sodium lamps must have a minimum average rated life of 24,000 hours.

#### **86-6.02 LOW PRESSURE SODIUM LUMINAIRES**

Each low pressure sodium luminaire must be completely assembled with a lamp and ballast, and must:

1. Be the enclosed type, either semi-cutoff or cutoff type.
2. Include housing, reflector, refractor or lens, lamp socket, integral ballast, removable ballast tray, lamp support, terminal strip, capacitor, and slip fitter. Reflector may be an integral part of the housing.

Luminaire housing must be minimum 1/16-inch thick, corrosion resistant die cast aluminum sheet and plate with concealed continuous welds, or minimum nominal wall thickness of 3/32-thick acrylonitrile-butadiene-styrene sheet material, on a cast aluminum frame that provides mounting for all electrical components and slip fitter.

Housing must be divided into optical and power compartments that are individually accessible for service and maintenance. Position and clamp luminaire to pipe tenon by tightening mounting bolts.

Painted exterior surface of luminaire must be finished with a fused coating of electrostatically applied polyester powder paint or other ultraviolet inhibiting film. Color must be aluminum gray.

High temperature neoprene, or equal, sealing ring must be installed in pipe tenon opening to prevent entry of water and insects into power and optical compartments.

Access to power unit assembly must be through a weathertight hinged cover, secured with spring type latches or captive screws, to luminaire housing.

Hardware must be stainless steel or cadmium plated. Use machine screws or bolts to secure removable components. Do not use sheet metal screws.

Semi-cutoff luminaires and molded refractor style cutoff luminaires must include a refractor. Other cutoff luminaires must include a flat lens.

Refractor must be 1-piece injection molded polycarbonate of 3/32 inch minimum thickness, or 1-piece injection molded acrylic of 1/8 inch minimum thickness. Flat lens must be 1-piece polycarbonate of 3/32 inch minimum thickness, mounted to metal frame. Refractor assembly and flat lens assembly must be constructed to rigidly maintain its shape, and hinged and secured with spring type latches to luminaire housing. Alternate methods of manufacturing refractor may be approved provided minimum specified thicknesses are maintained.

Lamp socket must be high temperature, flame retardant thermoset material with self-wiping contacts or equivalent. Socket must be rated for 660 W and 1,000 V(ac). Position of socket and support must maintain the lamp in correct relationship with reflector and refractor for designed distribution pattern.

Isofootcandle distribution must be ANSI Type III, short or Type IV, medium distribution, for cutoff or semi-cutoff luminaires.

With a 40-foot mounting height, each type of luminaire must maintain a minimum of 0.2 footcandle at least 60 feet each side, along the longitudinal roadway line below the luminaire, and a minimum of 0.35 footcandle at a transverse roadway distance from luminaire location equal to 1.5 times the luminaire mounting height.

Certified luminaire performance data must be provided. This data must include complete photometric test data in isofootcandle charts at a scale of 1 inch equals 20 feet, for the luminaire and lamp sizes shown on the plans.

Alternate data may be in horizontal footcandle values recorded on a 15' x 15' area extending 90 feet longitudinally each side of the light source, and 15 feet behind and 90 feet in front of the light source, for luminaire and lamp sizes, and mounting height shown on the plans. Horizontal footcandle levels in data submitted must equal or exceed levels specified. Failure to meet referenced values will be justification for rejection of the luminaires.

Photometric testing must be performed and certified by an independent and recognized testing laboratory.

Low pressure sodium lamps must:

1. Be 180 W, single-ended, bayonet base, tubular gas discharge lamp
2. Maintain a minimum of 93 percent of initial lumens during rated life and must comply with the following minimum performance requirements:

#### **Performance Requirements**

| Lamp Designation                 | ANSI L74-RF-180             |
|----------------------------------|-----------------------------|
| Initial Lumens                   | 33,000 lumens               |
| Rated Ave. Life (@ 10 hrs/Start) | 18,000 hours                |
| Operating Position               | Horizontal $\pm 20$ degrees |

3. Reach 80 percent of light output within 10 minutes and must restrike within 1 minute after an outage due to power interruption or voltage drop at the lamp socket
4. Identify the month and year of installation.
5. Have an autotransformer or high-reactance type ballast. The ballast must comply with the following:
  - 5.1. Lamp current crest factor must not exceed 1.8 at nominal line voltage
  - 5.2. Ballast loss must not exceed 24 percent for 180 W ballast at nominal line voltage

#### **Autotransformer or High-Reactance Type Ballast**

| Ballast Type                      | Power Factor  | Lamp Operation   |
|-----------------------------------|---|--|
| Autotransformer or High-Reactance | Not less than 90 percent when ballast is operated at nominal line voltage with a nominally-rated reference lamp | Lamp wattage regulation spread does not vary by more than $\pm 6$ percent for $\pm 10$ percent input voltage variation from nominal through life |

A multi-circuit connector must be included for quick disconnection of ballast tray.

#### **86-6.03 SOFFIT AND WALL LUMINAIRES**

Soffit and wall luminaire must be weatherproof and corrosion resistant.

Each flush-mounted soffit luminaire must consist of:

1. Metal body with two 1-inch minimum conduit hubs and provisions for anchoring into concrete
2. Prismatic refractor made of heat-resistant polycarbonate mounted in a door frame and clearly identified as to street side
3. Specular anodized aluminum reflector
4. Ballast located either within housing or in a ceiling pull box as shown on the plans
5. Lamp socket

The door frame assembly must be hinged, gasketed, and secured to body by at least 3 machine screws.

Each pendant soffit luminaire must be enclosed and gasketed, have an aluminum finish, and include:

1. Reflector with a specular anodized aluminum finish
2. Refractor made of heat-resistant polycarbonate
3. Optical assembly hinged and latched for lamp access and a device to prevent dropping
4. Ballast designed for operation in a raintight enclosure
5. Galvanized metal box with a gasketed cover, 2 captive screws, and 2 chains to prevent dropping and for luminaire mounting

Each wall-mounted luminaire must consist of:

1. Cast metal body
2. Prismatic refractor, made of glass, mounted in a door frame
3. Aluminum reflector with a specular anodized finish
4. Integral ballast
5. Lamp socket
6. Gasket between refractor and body
7. At least two 5/16-inch minimum diameter mounting bolts

Cast-aluminum bodies to be cast into or mounted against concrete must have a thick application of alkali-resistant bituminous paint on all surfaces to be in contact with concrete.

Each soffit luminaire and wall luminaire must include a 70 W high-pressure sodium lamp with a minimum average rated life of 24,000 hours. Each lamp socket must be positioned to locate the light center of the lamp within 1/2 inch of light center location of the luminaire design.

Ballast must comply with Section 86-6.01A, "High Pressure Sodium Lamp Ballasts." Wall luminaire ballast must be located in luminaire housing or, if shown on the plans, in a pull box adjacent to luminaire.

#### **86-6.04 PEDESTRIAN CROSSING FIXTURES**

Before starting fixture manufacturing, submit fixture design for approval. If requested, submit 1 complete prototype fixture for approval at least 30 days before manufacturing the fixtures. The prototype fixture will be returned to you, and if permitted, the fixture may be installed in the work.

Lens unit in door section must be formed of 1-1/2-inch methyl methacrylate rod cut and fire-glazed for a clear finish or a cast unit with equivalent tolerances and finish.

Lens must be secured to door section with an extruded lens retainer of 6063-T5 aluminum alloy that fits the lens shape. Lens retainer must fit the full length of lens on both sides. Continuous lens retainer for the full length of 3 lenses is allowed. Z bars of 5052-H32 or 5005-H14 aluminum alloy, 1/16 inch minimum thickness may be substituted for extruded lens retainer.

A captive positive-keyed screw-type latching device requiring a special socket wrench must be installed at upper edge to secure door in the closed position as shown on the plans. Furnish 2 special wrenches to the Engineer.

Each fixture must include a F48T12/CW rapid start fluorescent lamp with recessed, double contact base installed on back side of door directly behind lens.

Each lampholder must be UL listed for outdoor use without an enclosure and with 1,500 mA rapid start fluorescent lamp. Lampholder must be spring-loaded type.

For each lamp, the distance from face of lampholder to the lamp must be designed to provide a compression of at least 0.10-inch on the spring-type lampholder when lamp is in place. Lamp must have positive mechanical and electrical contact when lamp is in place. Socket on spring-type lampholder must have enough travel to allow lamp installation. Spring must not be a part of current-carrying circuit.

Ballast must be high-power-factor type with weatherproof leads for operation of one 48-inch rapid-start lamp. Ballast must be UL listed for outdoor operation on 110 to 125 V(ac) 60 Hz circuit and rated at 1,500 mA.

Conductors from ballast leads to lampholder must be minimum size of No. 16, stranded, and UL-listed copper AWM. Splicing of lampholder conductors to ballast leads must be performed by using mechanically secure connectors.

Conductors in fixture except ballast leads and entrance line conductors, must be UL-listed AWM.

Provide sufficient slack in the conductors to allow the fixture door to fully open.

Circuit conductors entering the fixture must be terminated on molded phenolic barrier-type terminal blocks rated at 15 A and 600 V(ac) and must have integral-type white waterproof-marking strips. Current-carrying parts of terminal blocks must be insulated from fixture with integral plugs or strips to provide protection from line-to-ground flashover voltage. Terminal blocks must be attached to wireway cover in top section. If you use sectionalized terminal blocks, each section must include an integral barrier on each side and be capable of rigid mounting and alignment.

Exposed surfaces of fixture must be uniform in appearance and free from significant defects, including improper fit, dents, deep scratches and abrasions, burrs, roughness, off-square ends, holes off-center or jagged, and surface irregularities. Screws for attaching components to fixture door, including Z bars, ballasts, and terminal block, must be tapped into door from the inside only. Screwheads, nuts, or other fasteners must not be removable from the outside.

#### **86-6.04A Pedestrian Undercrossing Fixtures**

Fixture shell must be cast aluminum alloy, industrial type or Federal Class 18 aluminum of 1/4 inch minimum thickness.

Door must be 1 piece of 6061-T6 aluminum alloy of 1/8 inch minimum thickness.

Continuous piano hinge must be Type 1100 aluminum alloy. The piano hinge must be welded or riveted to door section with 1/8 inch aluminum rivets. Matching holes must be drilled in the hinge and lower edge of fixture. After shell is in place, door assembly must be attached by minimum 3/8-inch No. 8 stainless steel self-tapping screws.

A neoprene gasket must be attached to frame to provide a cushion between the shell and the door.

Chain or other device must be included to prevent the door, when fully opened, from coming in contact with the undercrossing wall.

Fixture must be held in place by three 3/8" x 8" anchor bolts with 2 nuts each.

Fixture surfaces in contact with concrete, and with anchor bolts and nuts must be painted with a thick application of alkali-resistant bituminous paint. Paint must comply with MIL-P-6883.

Circuit conductor entering the fixture must be terminated on 2-position terminal blocks.

Both ends of fixture must have holes for 1-inch conduit. Unused holes must be plugged with pressed metal closures.

#### **86-6.04B Pedestrian Overcrossing Fixtures**

Fixture shell must consist of:

1. Top section and a door section of extruded 6063-T5 aluminum alloy, each with a nominal 1/8 inch wall thickness
2. 2 cast-end sections of 319 aluminum alloy
3. Internal wireway cover of 505-H32 aluminum alloy

Top section and door section must be joined together on one side by a continuous hinge formed as part of the 2 extrusions and must overlay to allow locking on the other side. Hinge must be treated with a silicone grease that will prevent the entrance of water by capillary action.



Wireway cover with 3/16 inch hemmed ends up and terminal blocks and circuit conductors must be inserted before welding end sections and must provide clearance at both ends for conductors. Cover must be fastened by at least two 1/4 inch No. 4 self-threading sheet metal screws with binding head and blunt point. You may substitute blind rivets of equivalent strength.

One or more bronze sash chains or other device must be included to prevent door from opening to an extent that will damage the hinge.

Lampholder must include heat-resistant circular cross section neoprene sealing gasket, silver-coated contacts, and waterproofed lead entrance for use with a 1,500 mA rapid start fluorescent lamp.

Ballast must be at most 13-1/4 inches long.

Circuit conductors entering the fixture must be terminated on 3-position terminal blocks.

Electrical system of pedestrian overcrossing must be grounded by a No. 8 copper wire installed in conduit from fixture to fixture, from end fixture to conduit fitting on end post and from conduit fitting on end post to grounding bushing in nearest pull box.

Ground wire must be secured to inside of telescoping sleeve end casting where conductors are carried and to the inside of Type LB conduit fitting on end post by a connecting lug and a No. 8 self-threading pan screw.

Lamp, lampholder, ballast, and fixture wire, must be attached to door section. Terminal blocks must be attached to top section or wireway cover.

Three No. 10, solid copper circuit conductors must be installed between terminal blocks as part of each completed fixture.

Before shipment to job site, fixture must be completely manufactured and assembled in the shop.

#### **86-6.05 INDUCTION SIGN LIGHTING FIXTURES**

Each induction sign lighting fixture must include housing with door, reflector, refractor or lens, lamp, power coupler, high frequency generator, socket assembly, fuse block, and fuses.

Each induction sign lighting fixture must:

1. Be designed for mounting near the bottom of sign panel on an overhead sign structure.
2. Be an enclosed design and be raintight and corrosion resistant.
3. Have a minimum average rating of 60,000 hours.
4. Be for a wattage of 87 W, 120/240 V(ac).
5. Have a power factor greater than 90 percent and total harmonic distortion less than 10 percent.
6. Be UL approved for wet locations and be FCC Class A-listed.
7. Not exceed 44 pounds in weight.
8. Include the manufacturer's brand name, trademark, model number, serial number, and date of manufacture on packaged assembly. Same information must be permanently marked on the outside and inside of housing.
9. Comply with minimum horizontal footcandle requirement shown on the plans.
10. Be a maximum height of 12 inches above the top of the mounting rails.

If fixture is located so that the light center of the lamp is 55 inches in front of, 1 foot below, and centered on a 10-foot high by 20-foot wide sign panel, the ratio of maximum to minimum illuminance level on the panel must not exceed 12 to 1 in 95 percent of the points measured. Illuminance gradient must not exceed 2 to 1 and is defined as the ratio of minimum illuminance on a 1-foot square of panel to that on an adjacent 1-foot square of panel.

Each fixture must have a mounting assembly that will allow fixture to be mounted on continuous slot channels. Mounting assembly must be either cast aluminum, hot-dip galvanized steel plate, or steel plate that has been galvanized and finished with a polymeric coating system or same finish that is used for housing.

Housing must have a door designed to hold a refractor or lens, and to open without the use of special tools. Housing and door must be manufactured of sheet or cast aluminum, and have a powder coat or polyester paint finish of a gray color resembling unfinished manufacturing. Sheet aluminum must comply with ASTM B 209 or B 209M for 5052-H32 aluminum sheet. External bolts, screws, hinges, hinge pins, and door closure devices must be corrosion resistant.

Housing must include weep holes.

Door must be hinged to housing on side of fixture away from the sign panel and include 2 captive latch bolts or other latching device. Door must be designed to lock in the open position, 50 degrees minimum from the plane of the door opening, with an 85-mph 3-second-wind-gust load striking the door from either side.

Door and housing must be gasketed to be raintight and dusttight. Thickness of gasket must be 1/4 inch, minimum.

Fixture height must be less than 12 inches above the top of mounting rails.

Reflector must be 1 piece, made from specularly finished aluminum protected with an electrochemically applied anodized finish or a chemically applied silicate film, and designed so deposited water due to condensation will drain away. Reflector must be secured to housing with a minimum of 2 screws and removable without removing any fixture parts. Do not attach reflectors to outside of housing.

Refractor or lens must have a smooth exterior and must be manufactured from the material as follows:

| <b>Refractor and Lens Material Requirements</b> |  |
|---|--|
| Component                                       | Manufactured From                                    |
| Flat lens                                       | Heat-resistant glass                                 |
| Convex lens                                     | Heat resistant, high-impact resistant tempered glass |
| Refractor                                       | Borosilicate heat resistant glass                    |

Refractor and convex lens must be designed or shielded so no fixture luminance is visible if fixture is approached directly from the rear and viewing level is the bottom of the fixture. If a shield is used, it must be an integral part of the door casting.

Each fixture must include an 85 W induction lamp with an interior wall that is fluorescent phosphor-coated. Light output must be at least 70 percent at 60,000 hours. Lamp must have a minimum color-rendering index of 80, be rated at a color temperature of 4,000K and be removable without the use of tools.

Lamp socket must be a porcelain enclosed mogul type with a shell that contains integral lamp grips to assure electrical contact under normal vibration conditions. Center contact must be spring-loaded. Shell and center contact must be nickel-plated brass. Socket must be rated for 1,500 W and 600 V(ac).

Power coupler must include a construction base with antenna, heat sink, and electrical connection cable, and be designed so it can be removed with common hand tools.

High frequency generator must:

1. Start and operate lamps at an ambient temperature of -25 °C or greater for the rated life of the lamp
2. Operate continuously at ambient air temperatures from -25 °C to 25 °C without reduction in generator life
3. Have a design life of at least 100,000 hours at 55 °C
4. Have an output frequency of 2.65 MHz  $\pm$  10 percent
5. Have radio frequency interference that complies with FCC Title 47, Part 18, regulations regarding harmful interference
6. Be replaceable with common hand tools
7. Mounted so the fixture can be used as a heat sink

Conductor terminal must be identified by the component terminal the conductor connects to.

Submit a copy of the high frequency generator test methods and results from the manufacturer with each lot of fixtures.

Each fixture must include a barrier-type fuse block for terminating field connections. Fuse block must:

1. Be secured to housing and be accessible without removal of any fixture parts
2. Be mounted to leave a minimum of 1/2 inch air space from sidewalls of housing
3. Be designed for easy removal of fuses with a fuse puller, be rated at 600 V(ac), and have box terminals.

Fuses must be 13/32-inch diameter, 1-1/2 inch long ferrule type and UL or NRTL listed. For 120 V(ac) input fixture, only the ungrounded conductor must be fused and there must be a solid link between the neutral and the high frequency generator.

If shown on the plans, include a wire guard to prevent damage to the refractor or lens. Guard must be constructed of 1/4-inch minimum diameter galvanized steel wire, and either hot-dip galvanized or electroplated-zinc coated as specified in ASTM B 633, Service Condition SC4 with a clear chromate dip treatment. Guard elements must be spaced to prevent rocks larger than 1-1/2-inch diameter from passing through.

#### **86-6.06 SIGN LIGHTING FIXTURES FOR FLASHING BEACON**

Sign lighting fixture must:

1. Be UL or NRTL listed for outdoor installation

2. Include a hood with side outlet tapped for conduit, a symmetrical 10-inch steel reflector with a white porcelain-enamel finish, and a medium base socket
3. Be rated at 150 W minimum

#### **86-6.07 INTERNALLY ILLUMINATED STREET NAME SIGNS**

Sign fixture must be:

1. Designed and constructed to prevent deformation or failure when subjected to an 85 mph 3-second-wind-gust load as specified in AASHTO publication, "Standard Specifications for Structural Supports of Highway Signs, Luminaires and Traffic Signals," and its interim revisions
2. Manufactured from all new material and all ferrous parts must be galvanized or cadmium-plated
3. Type A or B signs

Top and bottom must be formed or extruded aluminum and must be attached to formed or cast aluminum end fittings. Housing must be designed for continuous sealing between top and bottom assemblies, and end fittings, and be constructed to resist torsional twist and warp. Opening or removing 1 panel must allow access to the interior of the sign for lamp, ballast, and fuse replacement.

Photoelectric unit sockets are not allowed.

For Type A sign, both sides must be hinged at the top to allow installation or removal of sign panel, and to allow access to interior of sign.

For Type B sign, sign panel must be slide-mounted into housing.

Reflectors may be used to obtain required sign brightness. Reflectors must be formed aluminum with acrylic baked white enamel surface having a minimum reflectance of 0.85.

Sign panel must be slide-mounted or rigid-mounted in a frame, with white legend, symbols, arrows, and border on each face. Background must be green.

Sign panels surface must be evenly illuminated. Average of brightness readings for letters must be 150 foot-lamberts, minimum. Light transmission factor of sign panel must provide a letter to background brightness ratio between 10 to 1 and 20 to 1. Background luminance must not vary by more than 40 percent from the average background brightness reading. Luminance of letters, symbols, and arrows must not vary by more than 20 percent from their average brightness readings.

Sign panels must be translucent, high impact, resistant plastic panels of one of the following:

1. Glass fiber reinforced acrylated resin
2. Polycarbonate resin
3. Cellulose acetate butyrate plastic

Paint on the outside of plastic must be protected by a plastic film that seals the front surface of panel and filters out ultraviolet radiation. Paint must be acrylic plastic type.

Surface must be free of blemishes in the plastic or coating that may impair the serviceability or detract from the general appearance and color matching of sign.

White or green color must not fade or darken when sign is exposed to an accelerated test of ultraviolet light equivalent to 2 years of outdoor exposure. Green color of sign, when not illuminated, must match Color No. 14109 of Federal Standard 595B.

Sign panel must not crack or shatter when a 1-inch diameter, steel ball with a weight of 2.4 ounces is dropped from a height of 8.5 feet above the sign panel to any point of sign panel. For this test, sign panel must be lying in a horizontal position and supported within its frame.

For Type A sign, gasket must be installed between sign panel frame and fixture housing to prevent water entry between frame and fixture housing. Gasket must be uniform and even-textured, and be the closed-cell, sponge-neoprene type, designed for use at temperatures between -20 °C and +74 °C.

Gasket must be neatly applied to thoroughly degreased, clean surface with a suitable heat-resistant adhesive that will not allow the gasket to slip at temperatures between -20 °C and +74 °C.

Ballast must be high power factor type and capable of starting the lamp at -20 °C and above.

Ballast for Type A sign must be rated at 200 mA. Ballasts for Type B sign must be rated at 430 mA. Ballast must be UL or NRTL listed for operation on 110 to 125 V(ac), 60 Hz circuits, and comply with ANSI C 82.1 and ANSI C 82.2.

Lampholder must be UL or NRTL listed for outdoor use and of the spring-loaded type. Lampholder must have silver-coated contacts and waterproofed entrance leads for use with a rapid-start fluorescent lamp. Removal of lamp from socket must de-energize the primary of ballast. Each lampholder must include heat-resistant, circular cross

section, partially-recessed neoprene ring to seal against lamp ends and protect electrical contacts from moisture, dirt or other injurious elements.

Distance between face of lampholders must be designed to provide compression of at least 0.10 inch on the spring-type lampholder when lamp is in place. Lamp must have positive mechanical and electrical contact when lamp is in place. Socket on spring-type lampholder must have sufficient travel to allow lamp installation. Spring must not be a part of current carrying circuit. Lampholder must match lamp requirements and must not increase cathode filament circuit resistance by more than 0.10  $\Omega$ .

Lamp must comply with ANSI C 78.

Wiring connections in fixture must be terminated on molded, phenolic, barrier-type, terminal blocks rated at 15 A, 1,000 V(ac), and must have integral-type white waterproof-marking strips. Current carrying parts of terminal blocks must be insulated from fixture with integral plugs or strips to provide protection from line-to-ground flashover voltage. If you choose to use sectionalized terminal blocks, each section must include an integral barrier on each side and be capable of rigid mounting and alignment. Terminal screws must be No. 10, minimum.

Fuses must be Type 3AG, miniature, slow-blowing type with appropriate current and voltage ratings.

Fuseholder must be a panel-mounting type with threaded or bayonet-type knob that grips the fuse tightly for extraction. Use a separate fuse for each ballast.

Screened weep holes must be constructed at strategic locations in members subject to moisture collection.

Fasteners, screws, and hardware must be passive stainless steel, Type 302 or 304, or aluminum Type 6060-T6.

Top of fixture housing must have 2 free-swinging mounting brackets. Each bracket must be adjustable vertically for leveling the sign to either a straight or curved mast arm. Bracket assembly must allow fixture to swing perpendicular to the sign panel.

Hinge pins for the free-swinging brackets must have a minimum diameter of 1/4 inch.

Message, as shown on the plans, must be displayed on both sign panels.

If not shown on the plans, the message and the size of symbols or arrows will be given by the Engineer at your request. Letters must be 8-inch upper case and 6-inch lower case, Series E.

Fixture conductors must be UL- or NRTL-listed AWM stranded copper wire with 28 mils, minimum, thermoplastic insulation, rated at 1,000 V(ac) and rated for use at 90 °C. Conductors must be No. 16 minimum and must match color coding of ballast leads.

Conductors within the fixture must be secured with easily removable spring cross straps, not clamped, in the chassis or fixture. Straps must be installed 12 inches apart or less.

Stranded copper conductors connected to screw-type terminals must terminate in approved crimp-type ring connectors.

Splices are not allowed within fixture.

Submit shop drawings showing the message for each sign, including size of letters, symbols or arrows, as shown on the plans. If requested, you must supply, without cost to the State, sufficient samples of materials to be used in the manufacturing of the sign or a complete sign assembly, to allow adequate testing and evaluation of compliance to specified requirements.

## **86-6.08 PHOTOELECTRIC CONTROLS**

Photoelectric controls must be capable of directly switching multiple lighting systems.

### **86-6.08A Types**

Photoelectric control type must comply with the following:

**Photoelectric Control Types**

|          |  |
|----------|--|
| Type I   | Includes a remote photoelectric unit and a test switch housed in an enclosure.   |
| Type II  | Includes a remote photoelectric unit, a separate contactor located in a service equipment enclosure, and a test switch located in service equipment enclosure. |
| Type III | Includes a remote photoelectric unit, a separate contactor, and a test switch housed in an enclosure.  |
| Type IV  | Includes a photoelectric unit that plugs into an EEC-NEMA twist-lock receptacle integral with the luminaire.   |
| Type V   | Includes a photoelectric unit, contactor, and test switch located in service equipment enclosure.  |

A switch to allow manual operation of lighting circuit must be included for each Type I, Type II, Type III, and Type V photoelectric control. Switches must be single-hole mounting toggle type, single-pole, single-throw, rated at 12 A with a voltage rating that matches the circuit. Switches must have an indicating nameplate reading "Auto-

Test" and be connected in parallel with the load contacts of the photoelectric unit. Test switches must not have an "OFF" position.

Photoelectric unit for Types I, II, and III photoelectric controls, must be pole-top mounted.

#### **86-6.08B Equipment Details**

##### **86-6.08B(1) Photoelectric Unit**

Photoelectric unit must:

1. Have an output in response to changing light levels. Response level must remain stable throughout life of control unit.
2. Have a "turn-on" between 1 and 5 footcandles, and a "turn-off" between 1.5 and 5 times "turn-on." Measurements must be made by procedures in EEI-NEMA standards for physical and electrical interchangeability of light-sensitive control devices used in the control of roadway lighting.
3. Have a EEI-NEMA type receptacle. Mounting brackets must be used where pole-top mounting is not possible. Photoelectric controls must be installed at locations show on the plans and oriented.
4. Be screened to prevent artificial light from causing cycling.
5. Have a supply voltage rating of 60 Hz, 105-130 V(ac), 210-240 V(ac), or 105-240 V(ac), as specified.
6. Have a load rating of 800 W minimum, incandescent, high intensity discharge, or fluorescent.
7. Operate at a temperature range of -20 °C to 55 °C.
8. Have a power consumption less than 10 W.
9. Be housed in a weatherproof enclosure.
10. Have a base with a 3-prong, EEI-NEMA standard, twist-lock plug mounting.
11. Have a "fail-on" feature.

Unit components must not require periodic replacement.

Photoelectric controls, except Type IV and Type V, must include a 4-inch minimum inside diameter, pole-top mounting adaptor containing a terminal block, and cable supports or clamps to support pole wires.

For switching 480 V(ac), 60 Hz circuits, a 100 VA, minimum, 480/120 V(ac) transformer must be installed in the contactor enclosure to allow 120 V(ac) for the photoelectric control unit. If more than 1 photoelectric unit is to be installed at a location, a single transformer with a volt-ampere rating capable of handling the total controlled load, may be used.

##### **86-6.08B(2) Contactor**

Contactor must:

1. Have contacts rated to switch the specified lighting load
2. Be normally open
3. Be the mechanical armature type with contacts of fine silver, silver alloy, or superior alternative material

##### **86-6.08B(3) Enclosure**

Enclosure for Type I and Type III photoelectric controls must be NEMA 3R. Enclosure must be supplied with a factory-applied rust-resistant prime coat and finish coat. Two applications of paint to match the color of the standard must be applied as specified in Section 86-2.16, "Painting." Enclosure may be hot-dip galvanized instead of painting. A minimum of 2-1/2 inches must be provided between contactor terminals and end of enclosure for wiring connections. Enclosure must be mounted on the same standard as the photoelectric unit at a height of about 6 feet above finished grade.

##### **86-6.08B(4) Terminal Blocks**

Terminal blocks must be rated at 25 A, 600 V(ac), molded from phenolic or nylon material, and of the barrier type with plated-brass screw terminals and integral-type marking strips.

#### **86-6.09 TRANSFORMERS**

Multiple-to-multiple transformers must be single-phase dry type designed for operation on a 60 Hz supply.

### 86-6.09A Electrical Requirements

Transformers must have a decal showing a connection diagram. Diagram must show either color-coding or wire-tagging with primary (H1, H2) or secondary (X1, X2) markers, and the primary and secondary voltage and volt-ampere rating. Transformers must comply with the following:

| Transformer Electrical Requirements           |   |
|---|---|
| Transformer Characteristic                    | Multiple-to-Multiple Unit                         |
| Rating  | 120/480 V(ac), 240/480 V(ac),<br>or 480/120 V(ac) |
| Efficiency                                    | Exceed 95 percent                                 |
| Secondary Voltage Regulation<br>and Tolerance | ±3 percent from half load to<br>full load         |

Secondary 480 V(ac) windings must be center-tapped.

### 86-6.09B Physical Requirements

External leads for multiple-to-multiple secondary connections must be Type USE, No. 10, rated 600 V(ac).

Transformer leads must extend a minimum of 12 inches from the case.

Transformer insulation must be NEMA 185 C or better.

Multiple-to-multiple transformers must withstand the application of 2,200 V(ac) from core to coils and from coil to coil for a 1-minute period.

The above tests must be made immediately after operation of transformer at full load for 24 hours.

Non-submersible transformers must include metal half-shell coil protection, have moisture resistant synthetic varnish impregnated windings, and be suitable for outdoor operation in a raintight enclosure.

Each transformer to be installed in a pull box must be the submersible type and include a handle and a hanger.

### 86-6.09C Submersible Type Transformers

Submersible type transformers must be securely encased in a rugged corrosion resistant, watertight case and must withstand a 5-day test submerged in 2 feet of salt water, 2 percent salt by weight, with 12-hour on and off periods. The operating periods must be at full load.

Leads of submersible transformers must be brought out through one or more sealed hubs and secured to withstand a 100 pound static pull without loosening or leaking.

## 86-6.10 (BLANK)

## 86-6.11 FALSEWORK LIGHTING

### 86-6.11A General

Falsework lighting must include lighting to illuminate the pavement, portals, and pedestrian walkways at or under openings in the falsework required for traffic.

Lighting for pedestrian walkway illumination must be installed at all pedestrian openings through or under falsework.

Before starting falsework opening construction, you must submit a plan of proposed lighting installations for review and obtain approval. Approval will be made as specified in Section 5-1.02, "Plans and Working Drawings."

You must design falsework lighting so that required maintenance can be performed with a minimum of inconvenience to public traffic. Closing of traffic lanes for routine maintenance will not be permitted on roadways with posted speed limits greater than 25 mph.

Pavement under falsework with portals less than 150 feet apart and falsework portals must be illuminated only during the hours of darkness as defined in Division 1, Section 280, of the California Vehicle Code. Photoelectric switches must be used to control falsework lighting systems. Pavement under falsework with portals 150 feet or more apart and all pedestrian openings through falsework must be illuminated 24 hours per day.

Lighting fixtures must be aimed to avoid glare to oncoming motorists.

Type NMC cable with No. 12 minimum conductors, with ground wire, must be used. Fasten cable to supporting structure at sufficient intervals to adequately support cable and within 12 inches from every box or fitting. Conductors within 8 feet of ground must be enclosed in a 1/2 inch or larger metal conduit.

Each illumination system must be on a minimum of 1 separate branch circuit at each bridge location. Each branch circuit must be fused, not to exceed 20 A.

For falsework lighting, you must arrange with the serving utility to complete service connections. You must pay for energy, line extension, service, and service hookup costs.

At completion of project or when ordered by the Engineer, falsework lighting equipment will become your property and you must remove it from the job site.

You may propose a lighting plan that fulfills light intensity requirements to the systems specified herein. You must supply sufficient data to allow evaluation of alternative methods.

#### **86-6.11B Pavement Illumination**

Illumination of pavement at vehicular openings through falsework must comply with the following:

1. Fixture must include R/FL commercial type floodlamp holder with protective covers.
2. Fixture must be fully adjustable with brackets and locking screws, and allow mounting directly to a standard metal junction box.
3. Lamp must be medium-base 120 V(ac), 120 W, minimum, PAR-38 quartz-halogen floodlamp.
4. A continuous row of fixture types required must be installed at locations and spacing specified. Fixtures must be installed beneath falsework structure, with the end fixtures not further than 10 feet inside portal faces. Fixtures must be installed and energized immediately after the members supporting them have been erected.
5. Fixtures along the sides of the opening must be placed not more than 4 feet behind or 2 feet in front of the roadway face of the temporary railing. Mounting heights of fixtures must be between 12 and 16 feet above the roadway surface and must present an unobstructed light pattern on the pavement.

#### **86-6.11C Portal Illumination**

Illumination of falsework portals must comply with the following:

1. On each side of each entrance portal, plywood sheet clearance guides, 4 feet wide by 8 feet high, must be fastened vertically, facing traffic, with the bottom of the panel 3 feet to 4 feet above the roadway. The center of the panel must be located approximately 3 feet horizontally behind the roadway face of the railing. Panels must be freshly painted for each installation with not less than 2 applications of flat white paint. Paint testing will not be required.
2. If ordered by the Engineer, in order to improve the general appearance of the painted surfaces, you must repaint designated areas and that painting will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."
3. Falsework portals must be illuminated on the side facing traffic with 150 W, minimum, PAR reflector floodlamps mounted on the structure directly over each vertical support adjacent to the traveled way, as needed to uniformly illuminate the exterior falsework beam, the clearance guides, and the overhead clearance sign. Each lamp must be supported approximately 16 feet above the pavement and approximately 6 feet in front of the portal face.
4. Portal lighting and clearance guides must be installed on the day that vertical members are erected.

#### **86-6.11D Pedestrian Walkway Illumination**

Illumination of pedestrian openings through or under falsework must comply with the following:

1. Fixtures must be flush-mounted in the overhead protection shield and equipped with a damage-resistant clear polycarbonate diffuser lens. Lamps must be standard incandescent 100 W, 120 V(ac).
2. Fixtures must be centered over the passageway at intervals of not more than 15 feet with the end fixtures not more than 7 feet inside the end of the pedestrian openings.
3. Pedestrian passageway light systems must be installed immediately after the overhead protection shield is erected.

### **86-7 REMOVING, REINSTALLING OR SALVAGING ELECTRICAL EQUIPMENT**

#### **86-7.01 REMOVING ELECTRICAL EQUIPMENT**

Existing electrical equipment, pull boxes, and conduits, to be removed and not reused or salvaged, become your property and you must dispose of it under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way." Unused underground conduit may be abandoned in place after all conductors have been removed, except that conduit terminations from conduit to be abandoned must be removed from pull boxes to remain.

Exercise care in salvaging equipment so that it will not be damaged or destroyed. Mast arms must be removed from standards. Luminaires, signal heads, and signal mounting assemblies must be removed from standards and mast arms.

Holes resulting from removing pull boxes must be filled with material equivalent to the surrounding material.

**86-7.02 REINSTALLING REMOVED ELECTRICAL EQUIPMENT**

If removed electrical equipment is to be reinstalled, you must supply all necessary materials and equipment, including signal mounting assemblies, anchor bolts, nuts, washers, and concrete as required to complete the new installation.

Luminaires to be reinstalled must be cleaned and relamped.

Existing materials required to be reused and found to be unsatisfactory by the Engineer must be replaced with new material and the replacement cost will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

**86-8 PAYMENT**

**86-8.01 PAYMENT**

The contract lump sum price or prices paid for signal, ramp metering, flashing beacon, lighting, sign illumination, traffic monitoring station, highway advisory radio systems, closed circuit television systems, or combinations thereof; for modifying or removing those systems; for temporary systems; or the lump sum or unit prices paid for various units of those systems; or the lump sum or per foot price paid for conduit of the various sizes, types, and installation methods listed in the Engineer's Estimate include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing and installing, modifying, or removing the systems, combinations or units thereof, including any necessary pull boxes (except if the type required is shown as a separate contract item); excavation and backfill; concrete foundations (except if shown as a separate contract item); pedestrian barricades; furnishing and installing illuminated street name signs; installing sign panels on pedestrian barricades, on flashing beacon standards, and on traffic signal mast arms; restoring sidewalk, pavement and appurtenances damaged or destroyed during construction; salvaging existing materials; and making all required tests, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

If poles for electrical systems are manufactured from a source located more than 300 air-line miles from Sacramento and Los Angeles, the Department will deduct \$5,000 for inspection costs for each inspection site. If poles for electrical systems are manufactured from a source located more than 3,000 air-line miles from Sacramento and Los Angeles, the Department will deduct \$8,000 for inspection costs for each inspection site.

Full compensation for all additional materials and labor, not shown on the plans or specified, that are necessary to complete the installation of the various systems, is included in the prices paid for the systems, or units thereof, except as provided in Section 86-1.06, "Maintaining Existing and Temporary Electrical Systems," and no additional compensation will be allowed therefor.

If shown as a contract item, the contract price paid per foot for cast-in-drilled-hole concrete pile (signal foundation) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing reinforced concrete pile foundations of the size shown on the Engineer's Estimate, including drilling holes, disposing of the material resulting from drilling holes, furnishing and placing anchor bolt assemblies and reinforcing steel, complete in place, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

If shown as a contract item, non-reinforced PCC foundations will be measured and paid for by the cubic yard for foundation concrete in the same manner as specified for minor concrete (minor structure) in Section 51, "Concrete Structures."

If shown as a separate contract item by the lump sum or per foot, interconnection conduit and cable includes all interconnection conductors, and conduit and pull boxes containing interconnection cable and no other conductors. The quantity of interconnection conduit and cable to be paid for by the foot is the length of that conduit. Compensation for conduit containing interconnection cable and other conductors is included in the contract price paid for the item requiring the other conductors.

Full compensation for furnishing, installing, maintaining, and removing falsework lighting equipment is included in the contract prices paid for the items of work involved in the structure that requires the falsework lighting and no additional compensation will be allowed therefor.

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## **SECTION 88 ENGINEERING FABRICS**

**(Issued 01-20-12)**

**Replace Section 88 with:**

### **SECTION 88 GEOSYNTHETICS**

#### **88-1.01 GENERAL**

##### **88-1.01A Summary**

Section 88 includes specifications for geosynthetics. Geosynthetics are used for:

1. Filtration
2. Drainage
3. Reinforcement
4. Water pollution control
5. Channel and shore protection
6. Pavement interlayer
7. Separation and stabilization

##### **88-1.01B Submittals**

Submit:

1. Certificate of Compliance under Section 6-1.07, "Certificates of Compliance"
2. Samples representing each lot
3. Minimum average roll values (MARV)

Label submittals with the manufacturer's name and product information.

##### **88-1.01C Quality Control and Assurance**

Treat geosynthetics to resist degradation from exposure to sunlight. Using covers, protect geosynthetics from moisture, sunlight, and shipping and storage damage.

#### **88-1.02 FILTRATION**

##### **88-1.02A Filter Fabric**

Geosynthetics used for filter fabric must be permeable and nonwoven. Filter fabric must consist of 1 of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Filter fabric must comply with:

| Filter Fabric   |        |               |         |         |
|---|--------|---------------|---------|---------|
| Property  | ASTM   | Specification |         |         |
|   |        | Class A       | Class B | Class C |
| Grab breaking load, 1-inch grip, lb minimum in each direction               | D 4632 | 157           |         |         |
| Apparent elongation, percent minimum in each direction                      | D 4632 | 50            |         |         |
| Puncture strength, lb minimum   | D 6241 | 600           |         |         |
| Ultraviolet resistance, percent minimum retained grab breaking load, 500 hr | D 4355 | 70            |         |         |
| Permittivity, sec <sup>-1</sup> minimum                                     | D 4491 | 0.5           | 0.2     | 0.1     |
| Apparent opening size, average roll value, U.S. Standard sieve size maximum | D 4751 | 40            | 60      | 70      |

### 88-1.03 DRAINAGE

#### 88-1.03A Geocomposite Wall Drain

Geocomposite wall drain must consist of a polymeric core with filter fabric integrally bonded to 1 or both sides of the core creating a stable drainage void.

Filter fabric must comply with Section 88-1.02, "Filtration."

Geocomposite wall drain must comply with:

| Geocomposite Wall Drain   |        |               |
|---|--------|---------------|
| Property  | ASTM   | Specification |
| Thickness with fabric, inches maximum                                 | --     | 2             |
| Transmissivity, gradient = 1.0, normal stress = 5,000 psf, gal/min/ft | D 4716 | 4             |

### 88-1.04 REINFORCEMENT

#### 88-1.04A Geotechnical Subsurface Reinforcement

##### General

Geosynthetic used for geotechnical subsurface reinforcement must be either of the following:

1. Geotextile
2. Geogrid

Geotextile permittivity must be at least 0.05 sec<sup>-1</sup> determined under ASTM D 4491.

Geogrid must have a regular and defined open area. The open area must be from 50 to 90 percent of the total grid area.

##### Long Term Design Strength

Long Term Design Strength (LTDS) of geosynthetic reinforcement is the ultimate tensile strength in the primary strength direction divided by reduction factors. Calculate the LTDS from the guidelines in Geosynthetic Research Institute (GRI) Standard Practice GG4a, GRI GG4b, or GRI GT7.

The product of the appropriate reduction factors must be at least 1.30. Determine the reduction factor for creep using a 75-year design life for permanent applications and a 5-year design life for temporary applications. Determine the installation damage reduction factor based on the characteristics of the backfill materials used.

If test data is not available, use default values of reduction factors in the GRI Standard Practice to calculate LTDS.

Submit the LTDS and its supporting calculations at least 15 days before placing geosynthetic reinforcement. Do not install before the Engineer's approval. The LTDS must be signed by an engineer who is registered as a civil engineer in the State.

#### 88-1.05 WATER POLLUTION CONTROL

Geosynthetics used for water pollution control must comply with:

| Water Pollution Control Geosynthetics  |        |             |           |                     |           |                    |                 |           |
|--|--------|-------------|-----------|---------------------|-----------|--------------------|-----------------|-----------|
| Property   | ASTM   | Application |           |                     |           |                    |                 |           |
|  |        | Silt Fence  |           | Sediment Filter Bag |           | Gravel-Filled Bags | Temporary Cover |           |
|  |        | Woven       | Non-woven | Woven               | Non-woven |                    | Woven           | Non-woven |
| Grab breaking load, 1-inch grip, lb minimum in each direction                          | D 4632 | 120         | 120       | 200                 | 250       | 205                | 200             | 200       |
| Apparent elongation, percent minimum, in each direction                                | D 4632 | 15          | 50        | 10                  | 50        | --                 | 15              | 50        |
| Water flow rate, gallons per minute/square foot minimum and maximum average roll value | D 4491 | 10 - 100    | 100 - 150 | 100 - 200           | 75 - 200  | 80 - 150           | 4 - 10          | 80 - 120  |
| Permittivity, $\text{sec}^{-1}$ minimum  | D 4491 | 0.05        | 1.1       | 1.0                 | 1.0       | 0.2                | 0.05            | 1.0       |
| Apparent opening size, inches maximum average roll value                               | D 4751 | 0.023       | 0.012     | 0.023               | 0.012     | 0.016              | 0.023           | 0.012     |
| Ultraviolet resistance, percent minimum retained grab breaking load, 500 hr.           | D 4355 | 70          | 70        | 70                  | 70        | 70                 | 70              | 70        |

#### 88-1.06 CHANNEL AND SHORE PROTECTION

##### 88-1.06A Rock Slope Protection

Rock slope protection (RSP) fabric must be a permeable, nonwoven, needle-punched geotextile. RSP fabric consists of 1 of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Polymers must be either virgin compounds or clean reworked material. Do not subject virgin compounds to use or processing other than required for initial manufacture. Clean reworked material must be previously processed material from the processor's own production that has been reground, pelletized, or solvated. RSP fabric must not consist of more than 20 percent by weight of clean reworked material. Do not use recycled materials from either post-consumer or post-industrial sources.

Class 8 or Class 10 RSP fabric must comply with:

### Rock Slope Protection Fabric

| Property   | ASTM   | Specification |          |
|--|--------|---------------|----------|
|  |        | Class 8       | Class 10 |
| Weight, oz/yd <sup>2</sup><br>minimum  | D 5261 | 7.5           | 9.5      |
| Grab breaking load, lb<br>1-inch grip, min. in each direction                      | D 4632 | 200           | 250      |
| Apparent elongation, percent<br>min., in each direction                            | D 4632 | 50            | 50       |
| Permittivity, sec <sup>-1</sup> ,<br>minimum                                       | D 4491 | 1.0           | 0.70     |
| Apparent opening size, U.S.<br>Standard sieve size<br>minimum and maximum          | D 4751 | 70 - 100      | 70 - 100 |
| Ultraviolet resistance, percent<br>minimum retained grab<br>breaking load, 500 hr. | D4355  | 70            | 70       |

## 88-1.07 PAVEMENT INTERLAYER

### 88-1.07A Paving Fabric

Geosynthetics used for paving fabric must be nonwoven. Paving fabric must comply with:

#### Geosynthetic Paving Fabric

| Property  | ASTM   | Specification |
|---|--------|---------------|
| Mass per unit area, oz/yd <sup>2</sup><br>minimum                 | D 5261 | 4.1           |
| Grab breaking load, lb<br>1-inch grip, minimum, in each direction | D 4632 | 100           |
| Apparent elongation, percent<br>minimum in each direction         | D 4632 | 50            |
| Hydraulic bursting strength, psi<br>minimum                       | D 3786 | 200           |
| Melting point, °F<br>minimum                                      | D 276  | 325           |
| Asphalt retention, gal/yd <sup>2</sup><br>minimum                 | D 6140 | 0.2           |

### 88-1.07B Paving Mat

Geosynthetics used for paving mat must be a nonwoven fiberglass and polyester hybrid material. Paving mat must comply with:

#### Geosynthetic Paving Mat

| Property  | ASTM   | Specification |
|---|--------|---------------|
| Breaking force, lb/2 inches<br>minimum            | D 5035 | 45            |
| Ultimate elongation, percent<br>maximum           | D 5035 | 5             |
| Mass per unit area, oz/ sq yd<br>minimum          | D 5261 | 3.7           |
| Melting point, °F<br>minimum                      | D 276  | 400           |
| Asphalt retention, gal/yd <sup>2</sup><br>minimum | D 6140 | 0.10          |

### 88-1.07C Paving Grid

Geosynthetics used for paving grid must be a geopolymer material formed into a grid of integrally connected elements with openings. Paving grid must comply with:

| Geosynthetic Paving Grid                                 |             |               |          |           |
|--|-------------|---------------|----------|-----------|
| Property   | Test        | Specification |          |           |
|  |             | Class I       | Class II | Class III |
| Tensile strength at ultimate, lb/in <sup>a</sup> minimum | ASTM D 6637 | 560 x 1,120   | 560      | 280       |
| Aperture size, inch minimum                              | Calipered   | 0.5           | 0.5      | 0.5       |
| Elongation, % maximum                                    | ASTM D 6637 | 12            | 12       | 12        |
| Mass per area, oz / sqyd minimum                         | ASTM D 5261 | 16            | 10       | 5.5       |
| Melting point, °F minimum                                | ASTM D 276  | 325           | 325      | 325       |

Note:

<sup>a</sup> For Class I, machine direction x cross direction. For Class II and Class III, both directions.

### 88-1.07D Paving Geocomposite Grid

Paving geocomposite grid consists of paving grid specified under Section 88-1.07C, "Paving Grid," bonded or integrated with paving fabric specified under Section 88-1.07A, "Paving Fabric."

Paving geocomposite grid must have a peel strength of at least 10 pounds per foot determined under ASTM D 413.

### 88-1.07E Geocomposite Strip Membrane

Geocomposite strip membrane must consist of various widths of strips manufactured from of asphaltic rubber and geosynthetics. Geocomposite strip membrane must comply with:

| Geocomposite Strip Membrane                                   |            |                                |
|---|------------|--------------------------------|
| Property  | ASTM       | Specification                  |
| Strip tensile strength, lbs/inch minimum                      | D 882      | 50                             |
| Elongation at break, % minimum                                | D 882      | 50                             |
| Resistance to puncture, lbs. minimum                          | E 154      | 200                            |
| Permeance, perms maximum                                      | E 96/E 96M | 0.10                           |
| Pliability, 1/4 inch mandrel with sample conditioned at 25 °F | D 146      | No cracks in fabric or bitumen |
| Melting point, °F   | D 276      | 325                            |

## 88-1.08 SEPARATION AND STABILIZATION

### 88-1.08A Subgrade Enhancement Geotextile

Subgrade enhancement geotextile must consist of either of the following:

1. Polyester
2. Polypropylene

Subgrade enhancement geotextile must comply with:

### Subgrade Enhancement Geotextile

| Property  | ASTM   | Specification <sup>a</sup> |          |          |          |          |
|---|--------|----------------------------|----------|----------|----------|----------|
|   |        | Class A1                   | Class A2 | Class B1 | Class B2 | Class B3 |
| Elongation at break, %  | D 4632 | <50                        | ≥50      | <50      | <50      | ≥50      |
| Grab tensile strength, lb minimum   | D4632  | 250                        | 160      | --       | 320      | 200      |
| Wide width tensile strength at 5% strain, lb/ft minimum                     | D 4595 | --                         | --       | 2,000    | --       | --       |
| Wide width tensile strength at ultimate strength, lb/ft minimum             | D 4595 | --                         | --       | 4,800    | --       | --       |
| Tear strength, lb minimum   | D 4533 | 90                         | 60       | --       | 120      | 80       |
| Puncture strength, lb minimum   | D 6241 | 500                        | 310      | 620      | 620      | 430      |
| Permittivity, sec <sup>-1</sup> minimum                                     | D 4491 | 0.05                       | 0.05     | 0.20     | 0.20     | 0.20     |
| Apparent opening size, inches maximum                                       | D 4751 | 0.012                      | 0.012    | 0.024    | 0.012    | 0.012    |
| Ultraviolet stability (retained strength after 500 hrs exposure), % minimum | D 4355 | 70                         | 70       | 70       | 70       | 70       |

Notes:

<sup>a</sup> Specifications are based on minimum average roll value in the weaker principle direction except apparent opening size is based on maximum average roll value.

### 88-1.09 PAYMENT

The Department measures and pays for geosynthetics under the specifications requiring their use.

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## SECTION 90 PORTLAND CEMENT CONCRETE (Issued 08-05-11)

**Replace Section 90 with:**

## SECTION 90 PORTLAND CEMENT CONCRETE

### 90-1 GENERAL

#### 90-1.01 DESCRIPTION

Portland cement concrete shall be composed of cementitious material, fine aggregate, coarse aggregate, admixtures if used, and water, proportioned and mixed as specified in these specifications.

The Contractor shall determine the mix proportions for concrete in conformance with these specifications.

Minor concrete shall contain not less than 505 pounds of cementitious material per cubic yard unless otherwise specified in these specifications or the special provisions.

Unless otherwise designated on the plans or specified in these specifications or the special provisions, the amount of cementitious material used per cubic yard of concrete in structures or portions of structures shall conform to the following:

| Use  | Cementitious Material Content<br>(Pounds/CY) |
|--|--|
| Concrete designated by compressive strength:     |  |
| Deck slabs and slab spans of bridges             | 675 min., 800 max.                           |
| Roof sections of exposed top box culverts        | 675 min., 800 max.                           |
| Other portions of structures                     | 590 min., 800 max.                           |
| Concrete not designated by compressive strength: |  |
| Deck slabs and slab spans of bridges             | 675 min.                                     |
| Roof sections of exposed top box culverts        | 675 min.                                     |
| Prestressed members                              | 675 min.                                     |
| Seal courses                                     | 675 min.                                     |
| Other portions of structures                     | 590 min.                                     |
| Concrete for precast members                     | 590 min., 925 max.                           |

Except for minor structures, the minimum required compressive strength for concrete in structures or portions of structures shall be the strength specified, or 3600 pounds per square inch at 28 days, whichever is greater.

Except for when a modulus of rupture is specified, the minimum required compressive strength for concrete shall be the strength specified, or 2,500 pounds per square inch, whichever is greater. Concrete shall be proportioned such that the concrete will attain the minimum required compressive strength.

If the specified 28-day compressive strength is 3,600 pounds per square inch or greater, the concrete is designated by compressive strength. For concrete with a 28-day compressive strength greater than 3,600 pounds per square inch, 42 days will be allowed to obtain the specified strength.

For concrete not designated by compressive strength, the Engineer may test the concrete for compressive strength. The concrete will be accepted if the compressive strength at 28 days attains 85 percent or more of the minimum required compressive strength.

Concrete shall be proportioned to conform to the following shrinkage limitations when tested in conformance with the requirements of AASHTO Designation: T 160, modified as follows:

| Condition                         | Maximum Shrinkage of Laboratory Cast Specimens at 28 days Drying (average of 3, %) |
|-----------------------------------|--|
| Paving and approach slab concrete | 0.050  |
| Bridge deck concrete              | 0.045  |

Note: Shrinkage requirement is waived for concrete that is used for precast elements.

Shrinkage tests shall be either:

- A. Performed by a laboratory accredited to perform AASHTO Designation: T 160, or
- B. Performed by a laboratory that maintains a current rating of 3 or better for the Cement and Concrete Reference Laboratory (CCRL) concrete proficiency sample program.

Laboratory cast specimens shall have a 4" x 4" cross section. Specimens shall be removed from the molds 23 ± 1 hours after mixing the concrete and placed in lime water at 73 ± 3 °F to 7 days age. A comparator reading shall be taken at 7 days age and recorded as the initial reading. Specimens then shall be stored in a humidity controlled room maintained at 73 ± 3 °F and 50 ± 4 percent relative humidity for the remainder of the test. Subsequent readings shall be taken at 7, 14, 21, and 28 days drying.

Test data verifying conformance to the shrinkage limitations shall be submitted with the mix design. Shrinkage testing data accepted by the Engineer no more than 3 years prior to the first working day of this contract will be acceptable for this entire contract, provided the data was for concrete with similar proportions and the same materials and material sources to be used on this contract. Concrete shall be considered to have similar proportions if, when compared to concrete to be used on this project, no more than 2 mix design elements are varied. Varied mix design elements shall fall within the tolerances in the following table:

| Mix Design Element                          | Tolerance (±) |
|---|---------------|
| Water to cementitious material ratio        | 0.03          |
| Total water content                         | 5 %           |
| Coarse aggregate (weight per cubic yard)    | 10 %          |
| Fine aggregate (weight per cubic yard)      | 10 %          |
| Supplementary cementitious material content | 5 %           |
| Admixture (as originally dosed)             | 25 %          |

Note: Admixtures must be of the same brand.

Before using concrete or in advance of revising the mix proportions, the Contractor shall submit in writing to the Engineer a copy of the mix design.

Compliance with cementitious material content requirements will be verified in conformance with procedures described in California Test 518 for cement content. For testing purposes, supplementary cementitious material (SCM) shall be considered to be cement. Batch proportions shall be adjusted as necessary to produce concrete having the specified cementitious material content.

If any concrete has a cementitious material, portland cement, or SCM content that is less than the minimum required, the concrete shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place and the Contractor shall pay to the State \$0.25 for each pound of cementitious material, portland cement, or SCM that is less than the minimum required. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract. The deductions will not be made unless the difference between the contents required and those actually provided exceeds the batching tolerances permitted by Section 90-5, "Proportioning." No deductions will be made based on the results of California Test 518.

The requirements of the preceding paragraph shall not apply to minor concrete.

## 90-2 MATERIALS

### 90-2.01 CEMENTITIOUS MATERIALS

Unless otherwise specified, cementitious material shall be either a combination of Type II or Type V portland cement and SCM, or a blended cement. No cementitious material shall be used in the work unless it is on the Department's Pre-Qualified Products List at the time of mix design submittal. Information regarding cementitious material qualification and placement on the Department's approved list can be obtained at the Transportation Laboratory.

Cementitious materials used in cast-in-place concrete for exposed surfaces of like elements of a structure shall be from the same sources and of the same proportions.

Cementitious materials shall be protected from moisture until used. Sacked cementitious materials shall be piled to permit access for tallying, inspecting, and identifying each shipment.

Facilities shall be provided to ensure that the various cementitious materials meeting this Section 90-2.01 are kept separate from each other and from other cementitious materials. A storage silo containing a cementitious material shall be emptied before using that silo for a different cementitious material. Blended cements with a percentage of SCM differing by more than 2 percentage points are considered different cementitious materials. Sampling cementitious materials shall be in conformance with California Test 125.

The Contractor shall furnish a Certificate of Compliance for cementitious materials in conformance with the provisions in Section 6-1.07, "Certificates of Compliance." The Certificate of Compliance shall indicate the source by name and location (including country, state, and city). If cementitious material is delivered directly to the job site, the Certificate of Compliance shall be signed by the cementitious material supplier. If the cementitious material is used in ready-mixed concrete or in precast concrete products purchased as such by the Contractor, the Certificate of Compliance shall be signed by the manufacturer of the concrete or product. If blended cement is used, the Certificate of Compliance shall include a statement signed by the blended cement supplier that indicates the actual percentage, by weight, of SCM in the blend. Weight of SCM shall be by weighing device conforming to Section 9-1.01, "Measurement of Quantities," or as determined by chemical analysis.

#### 90-2.01A Cement

Portland cement shall conform to the requirements in ASTM Designation: C 150 except the C<sub>3</sub>S content of Type II cement shall not exceed 65 percent.

Blended cement shall conform to the requirements for Portland Blast-Furnace Slag Cement, Type IS (MS) or Portland-Pozzolan Cement, Type IP (MS) in AASHTO Designation: M 240, except that the maximum limits on the pozzolan content shall not apply. Blended cement shall be comprised of Type II or Type V cement and SCM produced by intergrinding portland cement clinker and granulated blast furnace slag, ground granulated blast furnace



slag (GGBFS), or pozzolan; by blending portland cement and either GGBFS or finely divided pozzolan; or by a combination of intergrinding and blending.

In addition, Type II portland cement and Type V portland cement shall conform to the following requirements:

- A. The cement shall not contain more than 0.60-percent by mass of alkalies, calculated as the percentage of  $\text{Na}_2\text{O}$  plus 0.658 times the percentage of  $\text{K}_2\text{O}$ , when determined by methods as required in AASHTO Designation: T 105; and
- B. The autoclave expansion shall not exceed 0.50-percent

Type III portland cement shall be used only as specified or with the approval of the Engineer. Type III portland cement shall conform to the additional requirements listed above for Type II portland cement. The Contractor may use Type III portland cement in the manufacturing of precast concrete.

#### 90-2.01B Supplementary Cementitious Materials

Each supplementary cementitious material shall conform to one of the following:

- A. Fly ash conforming to the requirements in AASHTO Designation: M 295, Class F, and these specifications. The available alkali, as sodium oxide equivalent, shall not exceed 1.5 percent when determined in conformance with the requirements in ASTM Designation: C 311 or the total alkali, as sodium oxide equivalent, shall not exceed 5.0 percent when determined in conformance with the requirements in AASHTO Designation: T 105.
- B. Ultra fine fly ash (UFFA) conforming to the requirements in AASHTO Designation: M 295, Class F, and the following chemical and physical requirements:

| Chemical Requirements                                     | Percent  |
|---|----------|
| Sulfur Trioxide ( $\text{SO}_3$ )                         | 1.5 max. |
| Loss on ignition  | 1.2 max. |
| Available Alkalies (as $\text{Na}_2\text{O}$ ) equivalent | 1.5 max. |

| Physical Requirements  | Percent                    |
|--|----------------------------|
| Particle size distribution   |                            |
| Less than 3.5 microns  | 50                         |
| Less than 9.0 microns  | 90                         |
| Strength Activity Index with portland cement                                     |                            |
| 7 days   | 95 (minimum % of control)  |
| 28 days  | 110 (minimum % of control) |
| Expansion at 16 days when testing job materials in conformance with ASTM C 1567* | 0.10 max.                  |

\* In the test mix, Type II or Type V portland cement shall be replaced with at least 12% UFFA by weight.

- C. Raw or calcined natural pozzolans conforming to the requirements in AASHTO Designation: M 295, Class N, and the following requirements and these specifications. The available alkali, as sodium oxide equivalent, shall not exceed 1.5 percent when determined in conformance with the requirements in ASTM Designation: C 311 or the total alkali, as sodium oxide equivalent, shall not exceed 5.0 percent when determined in conformance with the requirements in AASHTO Designation: T 105.
- D. Metakaolin conforming to the requirements in AASHTO Designation: M 295, Class N, and the following chemical and physical requirements:

| Chemical Requirements   | Percent   |
|---|-----------|
| Silicon Dioxide ( $\text{SiO}_2$ ) + Aluminum Oxide ( $\text{Al}_2\text{O}_3$ ) | 92.0 min. |
| Calcium Oxide ( $\text{CaO}$ )  | 1.0 max   |
| Sulfur Trioxide ( $\text{SO}_3$ )   | 1.0 max.  |
| Loss on ignition  | 1.2 max.  |
| Available Alkalies (as $\text{Na}_2\text{O}$ ) equivalent                       | 1.0 max.  |

| Physical Requirements   | Percent  |
|---|--|
| Particle size distribution<br>Less than 45 microns                | 95   |
| Strength Activity Index with portland cement<br>7 days<br>28 days | 100 (minimum % of control)<br>100 (minimum % of control) |

- E. Ground Granulated Blast Furnace Slag (GGBFS) conforming to the requirements in AASHTO Designation: M 302, Grade 100 or Grade 120.
- F. Silica Fume conforming to the requirements of AASHTO Designation: M 307, with reduction in mortar expansion of 80 percent, minimum, using the cement from the proposed mix design.

Commingling of fly ash from different sources at uncontrolled ratios is permissible only if the following criteria are satisfied:

- A. Sources of fly ash to be commingled shall each produce fly ash that conforms to the requirements in AASHTO Designation: M 295, Class F.
- B. Testing of the commingled product is the responsibility of the fly ash supplier.
- C. Each fly ash's running average of relative density shall not differ from any other by more than 0.25 at the time of commingling.
- D. Each fly ash's running average of loss on ignition shall not differ from any other by more than one percent at the time of commingling.
- E. The final product of commingled fly ash shall conform to the requirements in AASHTO Designation: M 295, Class F.

#### 90-2.01C Required Use Of Supplementary Cementitious Materials

##### General

The amount of portland cement and SCM used in portland cement concrete shall conform to the minimum cementitious material content provisions in Section 90-1.01, "Description," or Section 90-4.05, "Optional Use of Chemical Admixtures," and these specifications.

The SCM content in portland cement concrete shall conform to one of the following:

- A. Any combination of portland cement and at least one SCM, satisfying Equations (1) and (2):

Equation (1)

$$\frac{(25 \times UF) + (12 \times FA) + (10 \times FB) + (6 \times SL)}{MC} \geq X$$

Where:

- UF = Silica fume, metakaolin, or UFFA, including the amount in blended cement, pounds per cubic yard.
- FA = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N with a CaO content up to 10 percent, including the amount in blended cement, pounds per cubic yard.
- FB = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N with a CaO content greater than 10 percent and up to 15 percent, including the amount in blended cement, pounds per cubic yard.
- SL = GGBFS, including the amount in blended cement, pounds per cubic yard.
- MC = Minimum amount of cementitious material specified, pounds per cubic yard.
- X = 1.8 for innocuous aggregate, 3.0 for all other aggregate.

Equation (2)

$$MC - MSCM - PC \geq 0$$

Where:

MC = Minimum amount of cementitious material specified, pounds per cubic yard.

MSCM = The minimum sum of SCMs that satisfies Equation (1) above, pounds per cubic yard.

PC = The amount of portland cement, including the amount in blended cement, pounds per cubic yard.

- B. 15 percent of Class F fly ash with at least 48 ounces of LiNO<sub>3</sub> solution added per 100 pounds of portland cement. CaO content of the fly ash shall not exceed 15 percent.

### **Precast Concrete**

The SCM content in precast portland cement concrete shall conform to one of the following:

- A. Any combination of portland cement and SCM, satisfying the following equation:

Equation (3)

$$\frac{(25 \times UF) + (12 \times FA) + (10 \times FB) + (6 \times SL)}{TC} \geq X$$

Where:

UF = Silica fume, metakaolin, or UFFA, including the amount in blended cement, pounds per cubic yard.

FA = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N with a CaO content up to 10 percent, including the amount in blended cement, pounds per cubic yard.

FB = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N with a CaO content greater than 10 percent and up to 15 percent, including the amount in blended cement, pounds per cubic yard.

SL = GGBFS, including the amount in blended cement, pounds per cubic yard.

TC = Total amount of cementitious material used in the mix, pounds per cubic yard.

X = 0.0 if precast members are constructed with portland cement concrete using aggregate that is "innocuous" in conformance with the provisions in Section 90-2.02, "Aggregates."

X = 3.0 for all other aggregate.

- B. 15 percent of Class F fly ash with at least 48 ounces of LiNO<sub>3</sub> solution added per 100 pounds of portland cement. CaO content of the fly ash shall not exceed 15 percent.
- C. Any combination of supplementary cementitious material and portland cement may be used if the expansion of cementitious material and aggregate does not exceed 0.10 percent when tested in conformance with the requirements in ASTM C 1567. Test data shall be submitted with each mix design. Test data accepted by the Engineer no more than 3 years prior to the first working day of this contract will be acceptable for this entire contract, provided the data was for the same concrete mix and the same materials and material sources to be used on this contract.

### **90-2.02 AGGREGATES**

To be considered innocuous, aggregate must be on the Department's approved list, "Innocuous Aggregates for use in Concrete." Information regarding aggregate qualification and placement on the Department's approved list can be obtained at the Transportation Laboratory.

Both coarse and fine aggregate must be on the approved list for the aggregate used in concrete to be considered innocuous.

Aggregates shall be free from deleterious coatings, clay balls, roots, bark, sticks, rags, and other extraneous material.

The Contractor shall provide safe and suitable facilities, including necessary splitting devices for obtaining samples of aggregates, in conformance with California Test 125.

Aggregates shall be of such character that it will be possible to produce workable concrete within the limits of water content provided in Section 90-6.06, "Amount of Water and Penetration."

Aggregates shall have not more than 10 percent loss when tested for soundness in conformance with the requirements in California Test 214. The soundness requirement for fine aggregate will be waived, provided that the durability index,  $D_f$ , of the fine aggregate is 60 or greater when tested for durability in conformance with California Test 229.

If the results of any one or more of the Cleanness Value, Sand Equivalent, or aggregate grading tests do not meet the requirements specified for "Operating Range" but all meet the "Contract Compliance" requirements, the placement of concrete shall be suspended at the completion of the current pour until tests or other information indicate that the next material to be used in the work will comply with the requirements specified for "Operating Range."

If the results of either or both the Cleanness Value and coarse aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete that is represented by the tests shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place, and the Contractor shall pay to the State \$3.50 per cubic yard for paving concrete and \$5.50 per cubic yard for all other concrete for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract.

If the results of either or both the Sand Equivalent and fine aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete which is represented by the tests shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place, and the Contractor shall pay to the State \$3.50 per cubic yard for paving concrete and \$5.50 per cubic yard for all other concrete for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract.

The 2 preceding paragraphs apply individually to the "Contract Compliance" requirements for coarse aggregate and fine aggregate. When both coarse aggregate and fine aggregate do not conform to the "Contract Compliance" requirements, both paragraphs shall apply. The payments specified in those paragraphs are in addition to any payments made in conformance with the provisions in Section 90-1.01, "Description."

No single Cleanness Value, Sand Equivalent, or aggregate grading test shall represent more than 300 cubic yards of concrete or one day's pour, whichever is smaller.

When the source of an aggregate is changed, the Contractor shall adjust the mix proportions and submit in writing to the Engineer a copy of the mix design before using the aggregates.

#### **90-2.02A Coarse Aggregate**

Coarse aggregate shall consist of gravel, crushed gravel, crushed rock, reclaimed aggregate, crushed air-cooled iron blast furnace slag or combinations thereof. Crushed air-cooled blast furnace slag shall not be used in reinforced or prestressed concrete.

Reclaimed aggregate is aggregate that has been recovered from plastic concrete by washing away the cementitious material. Reclaimed aggregate shall conform to all aggregate requirements.

Coarse aggregate shall conform to the following quality requirements:

| Tests   | California Test | Requirements |
|---|-----------------|--------------|
| Loss in Los Angeles Rattler (after 500 revolutions) | 211             | 45% max.     |
| Cleanness Value                                     |                 |              |
| Operating Range                                     | 227             | 75 min.      |
| Contract Compliance                                 | 227             | 71 min.      |

In lieu of the above Cleanness Value requirements, a Cleanness Value "Operating Range" limit of 71, minimum, and a Cleanness Value "Contract Compliance" limit of 68, minimum, will be used to determine the acceptability of the coarse aggregate if the Contractor furnishes a Certificate of Compliance, as provided in Section 6-1.07, "Certificates of Compliance," certifying that:

- A. Coarse aggregate sampled at the completion of processing at the aggregate production plant had a Cleanness Value of not less than 82 when tested in conformance with the requirements in California Test 227; and

- B. Prequalification tests performed in conformance with the requirements in California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

#### **90-2.02B Fine Aggregate**

Fine aggregate shall consist of natural sand, manufactured sand produced from larger aggregate or a combination thereof. Manufactured sand shall be well graded.

Fine aggregate shall conform to the following quality requirements:

| Test                | California Test | Requirements              |
|---------------------|-----------------|---------------------------|
| Organic Impurities  | 213             | Satisfactory <sup>a</sup> |
| Sand Equivalent:    |                 |                           |
| Operating Range     | 217             | 75, min.                  |
| Contract Compliance | 217             | 71, min.                  |

<sup>a</sup> Fine aggregate developing a color darker than the reference standard color may be accepted if 95% relative mortar strength is achieved when tested in conformance with ASTM C87.

In lieu of the above Sand Equivalent requirements, a Sand Equivalent "Operating Range" limit of 71, minimum, and a Sand Equivalent "Contract Compliance" limit of 68, minimum, will be used to determine the acceptability of the fine aggregate if the Contractor furnishes a Certificate of Compliance, as provided in Section 6-1.07, "Certificates of Compliance," certifying that:

- A. Fine aggregate sampled at the completion of processing at the aggregate production plant had a Sand Equivalent value of not less than 82 when tested by California Test 217; and
- B. Prequalification tests performed in conformance with California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

#### **90-2.03 WATER**

In conventionally reinforced concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 1,000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1,300 parts per million of sulfates as SO<sub>4</sub>, when tested in conformance with California Test 417. In prestressed concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 650 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1,300 parts per million of sulfates as SO<sub>4</sub>, when tested in conformance with California Test 417. In no case shall the water contain an amount of impurities that will cause either of the following results when compared to the same test using distilled or deionized water: 1) a change in the setting time of cement of more than 25 percent when tested in conformance with the requirements in ASTM Designation: C 191 or ASTM Designation: C 266 or 2) a reduction in the compressive strength of mortar at 14 days of more than 5 percent, when tested in conformance with the requirements in ASTM Designation: C 109.

In nonreinforced concrete work, the water for curing, for washing aggregates and for mixing shall be free from oil and shall not contain more than 2,000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, or more than 1,500 parts per million of sulfates as SO<sub>4</sub>, when tested in conformance with California Test 417.

In addition to the above provisions, water for curing concrete shall not contain impurities in a sufficient amount to cause discoloration of the concrete or produce etching of the surface.

Water reclaimed from mixer wash-out operations may be used in mixing concrete. The water shall not contain coloring agents or more than 300 parts per million of alkalis (Na<sub>2</sub>O + 0.658 K<sub>2</sub>O) as determined on the filtrate. The specific gravity of the water shall not exceed 1.03 and shall not vary more than ±0.010 during a day's operations.

#### **90-2.04 Admixture Materials**

Admixture materials shall be stored and dispensed in liquid form and conform to the following requirements:

- A. Chemical Admixtures—ASTM Designation: C 494.
- B. Air-entraining Admixtures—ASTM Designation: C 260.
- C. Lithium Nitrate shall be in an aqueous solution conforming to the following:

1. Lithium Nitrate ( $\text{LiNO}_3$ ) must be 30 percent +/- 0.5 percent by weight
2. Sulfate ( $\text{SO}_4$ ) must be less than 1000 ppm
3. Chloride (Cl) must be less than 1000 ppm
4. Alkalies ( $\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O}$ ) must be less than 1000 ppm

### 90-3 AGGREGATE GRADINGS

#### 90-3.01 GENERAL

Before beginning concrete work, the Contractor shall submit in writing to the Engineer the gradation of the primary aggregate nominal sizes that the Contractor proposes to furnish. If a primary coarse aggregate or the fine aggregate is separated into 2 or more sizes, the proposed gradation shall consist of the gradation for each individual size, and the proposed proportions of each individual size, combined mathematically to indicate one proposed gradation. The proposed gradation shall meet the grading requirements shown in the table in this section, and shall show the percentage passing each of the sieve sizes used in determining the end result.

The Engineer may waive, in writing, the gradation requirements in this Section 90-3.01 and in Sections 90-3.02, "Coarse Aggregate Grading," 90-3.03, "Fine Aggregate Grading," and 90-3.04, "Combined Aggregate Gradings," if, in the Engineer's opinion, furnishing the gradation is not necessary for the type or amount of concrete work to be constructed.

Gradations proposed by the Contractor shall be within the following percentage passing limits:

| Primary Aggregate Nominal Size | Sieve Size | Limits of Proposed Gradation |
|--------------------------------|------------|------------------------------|
| 1-1/2" x 3/4"                  | 1"         | 19 - 41                      |
| 1" x No. 4                     | 3/4"       | 52 - 85                      |
| 1" x No. 4                     | 3/8"       | 15 - 38                      |
| 1/2" x No. 4                   | 3/8"       | 40 - 78                      |
| 3/8" x No. 8                   | 3/8"       | 50 - 85                      |
| Fine Aggregate                 | No. 16     | 55 - 75                      |
| Fine Aggregate                 | No. 30     | 34 - 46                      |
| Fine Aggregate                 | No. 50     | 16 - 29                      |

Should the Contractor change the source of supply, the Contractor shall submit in writing to the Engineer the new gradations before their intended use.

#### 90-3.02 COARSE AGGREGATE GRADING

The grading requirements for coarse aggregates are shown in the following table for each size of coarse aggregate:

| Sieve Sizes | Percentage Passing Primary Aggregate Nominal Sizes |                     |                 |                     |                 |                     |                 |                     |
|-------------|--|---------------------|-----------------|---------------------|-----------------|---------------------|-----------------|---------------------|
|             | 1-1/2" x 3/4"                                      |                     | 1" x No. 4      |                     | 1/2" x No. 4    |                     | 3/8" x No. 8    |                     |
|             | Operating Range                                    | Contract Compliance | Operating Range | Contract Compliance | Operating Range | Contract Compliance | Operating Range | Contract Compliance |
| 2"          | 100  | 100                 | —               | —                   | —               | —                   | —               | —                   |
| 1-1/2"      | 88 - 100   | 85 - 100            | 100             | 100                 | —               | —                   | —               | —                   |
| 1"          | X ±18  | X ±25               | 88 - 100        | 86 - 100            | —               | —                   | —               | —                   |
| 3/4"        | 0 - 17   | 0 - 20              | X ±15           | X ±22               | 100             | 100                 | —               | —                   |
| 1/2"        | —  | —                   | —               | —                   | 82 - 100        | 80 - 100            | 100             | 100                 |
| 3/8"        | 0 - 7  | 0 - 9               | X ±15           | X ±22               | X ±15           | X ±22               | X ±15           | X ±20               |
| No. 4       | —  | —                   | 0 - 16          | 0 - 18              | 0 - 15          | 0 - 18              | 0 - 25          | 0 - 28              |
| No. 8       | —  | —                   | 0 - 6           | 0 - 7               | 0 - 6           | 0 - 7               | 0 - 6           | 0 - 7               |

In the above table, the symbol X is the gradation that the Contractor proposes to furnish for the specific sieve size as provided in Section 90-3.01, "General."

Coarse aggregate for the 1-1/2 inch, maximum, combined aggregate grading as provided in Section 90-3.04, "Combined Aggregate Gradings," shall be furnished in 2 or more primary aggregate nominal sizes. Each primary aggregate nominal size may be separated into 2 sizes and stored separately, provided that the combined material conforms to the grading requirements for that particular primary aggregate nominal size.

When the one inch, maximum, combined aggregate grading as provided in Section 90-3.04, "Combined Aggregate Gradings," is to be used, the coarse aggregate may be separated into 2 sizes and stored separately, provided that the combined material shall conform to the grading requirements for the 1" x No. 4 primary aggregate nominal size.

### 90-3.03 FINE AGGREGATE GRADING

Fine aggregate shall be graded within the following limits:

| Sieve Sizes | Percentage Passing |                     |
|-------------|--------------------|---------------------|
|             | Operating Range    | Contract Compliance |
| 3/8"        | 100                | 100                 |
| No. 4       | 95 - 100           | 93 - 100            |
| No. 8       | 65 - 95            | 61 - 99             |
| No. 16      | X $\pm$ 10         | X $\pm$ 13          |
| No. 30      | X $\pm$ 9          | X $\pm$ 12          |
| No. 50      | X $\pm$ 6          | X $\pm$ 9           |
| No. 100     | 2 - 12             | 1 - 15              |
| No. 200     | 0 - 8              | 0 - 10              |

In the above table, the symbol X is the gradation that the Contractor proposes to furnish for the specific sieve size as provided in Section 90-3.01, "General."

In addition to the above required grading analysis, the distribution of the fine aggregate sizes shall be such that the difference between the total percentage passing the No. 16 sieve and the total percentage passing the No. 30 sieve shall be between 10 and 40, and the difference between the percentage passing the No. 30 and No. 50 sieves shall be between 10 and 40.

Fine aggregate may be separated into 2 or more sizes and stored separately, provided that the combined material conforms to the grading requirements specified in this Section 90-3.03.

### 90-3.04 COMBINED AGGREGATE GRADINGS

Combined aggregate grading limits shall be used only for the design of concrete mixes. Concrete mixes shall be designed so that aggregates are combined in proportions that shall produce a mixture within the grading limits for combined aggregates as specified herein.

The combined aggregate grading, except when otherwise specified in these specifications or the special provisions, shall be either the 1-1/2 inch, maximum grading, or the 1 inch, maximum grading, at the option of the Contractor.

Grading Limits of Combined Aggregates

| Sieve Sizes | Percentage Passing |          |           |           |
|-------------|--------------------|----------|-----------|-----------|
|             | 1-1/2" Max.        | 1" Max.  | 1/2" Max. | 3/8" Max. |
| 2"          | 100                | —        | —         | —         |
| 1-1/2"      | 90 - 100           | 100      | —         | —         |
| 1"          | 50 - 86            | 90 - 100 | —         | —         |
| 3/4"        | 45 - 75            | 55 - 100 | 100       | —         |
| 1/2"        | —                  | —        | 90 - 100  | 100       |
| 3/8"        | 38 - 55            | 45 - 75  | 55 - 86   | 50 - 100  |
| No. 4       | 30 - 45            | 35 - 60  | 45 - 63   | 45 - 63   |
| No. 8       | 23 - 38            | 27 - 45  | 35 - 49   | 35 - 49   |
| No. 16      | 17 - 33            | 20 - 35  | 25 - 37   | 25 - 37   |
| No. 30      | 10 - 22            | 12 - 25  | 15 - 25   | 15 - 25   |
| No. 50      | 4 - 10             | 5 - 15   | 5 - 15    | 5 - 15    |
| No. 100     | 1 - 6              | 1 - 8    | 1 - 8     | 1 - 8     |
| No. 200     | 0 - 3              | 0 - 4    | 0 - 4     | 0 - 4     |

Changes from one grading to another shall not be made during the progress of the work unless permitted by the Engineer.

## **90-4 ADMIXTURES**

### **90-4.01 GENERAL**

Admixtures used in portland cement concrete shall conform to and be used in conformance with the provisions in this Section 90-4 and the special provisions. Admixtures shall be used when specified or ordered by the Engineer and may be used at the Contractor's option as provided herein.

Chemical admixtures and air-entraining admixtures containing chlorides as Cl in excess of one percent by weight of admixture, as determined by California Test 415, shall not be used.

Admixtures shall be uniform in properties throughout their use in the work. Should it be found that an admixture as furnished is not uniform in properties, its use shall be discontinued.

If more than one admixture is used, the admixtures shall be compatible with each other so that the desirable effects of all admixtures used will be realized.

Chemical admixtures shall be used in conformance with the manufacturer's written recommendations. The manufacturer's written recommendations shall include a statement that the admixtures are compatible with the types and amounts of SCMs used.

### **90-4.02 MATERIALS**

Admixture materials shall conform to the provisions in Section 90-2.04, "Admixture Materials."

### **90-4.03 ADMIXTURE APPROVAL**

No admixture brand shall be used in the work unless it is on the Department's current list of approved brands for the type of admixture involved. Information regarding admixture qualification and placement on the Department's list can be obtained at the Transportation Laboratory.

If the Contractor proposes to use an admixture of a brand and type on the current list of approved admixture brands, the Contractor shall furnish a Certificate of Compliance from the manufacturer, as provided in Section 6-1.07, "Certificates of Compliance," certifying that the admixture furnished is the same as that previously approved. If a previously approved admixture is not accompanied by a Certificate of Compliance, the admixture shall not be used in the work until the Engineer has had sufficient time to make the appropriate tests and has approved the admixture for use. The Engineer may take samples for testing at any time, whether or not the admixture has been accompanied by a Certificate of Compliance.

### **90-4.04 REQUIRED USE OF CHEMICAL ADMIXTURES**

If the use of a chemical admixture is specified, the admixture shall be used at the dosage specified, except that if no dosage is specified, the admixture shall be used at the dosage normally recommended by the manufacturer of the admixture.

### **90-4.05 OPTIONAL USE OF CHEMICAL ADMIXTURES**

The Contractor may use Type A or F, water-reducing; Type B, retarding; or Type D or G, water-reducing and retarding admixtures as described in ASTM Designation: C 494 to conserve cementitious material or to facilitate any concrete construction application subject to the following conditions:

- A. If a water-reducing admixture or a water-reducing and retarding admixture is used, the cementitious material content specified or ordered may be reduced by a maximum of 5 percent by weight, except that the resultant cementitious material content shall be not less than 505 pounds per cubic yard; and
- B. When a reduction in cementitious material content is made, the dosage of admixture used shall be no less than the dosage used in determining approval of the admixture.

The Contractor may use Type S admixtures conforming to the requirements in ASTM Designation: C 494.

Unless otherwise specified, a Type C accelerating chemical admixture conforming to the requirements in ASTM Designation: C 494, may be used in portland cement concrete. Inclusion in the mix design submitted for approval will not be required provided that the admixture is added to counteract changing conditions that contribute to delayed setting of the portland cement concrete, and the use or change in dosage of the admixture is approved in writing by the Engineer.

### **90-4.06 REQUIRED USE OF AIR-ENTRAINING ADMIXTURES**

When air-entrainment is specified or ordered by the Engineer, the air-entraining admixture shall be used in amounts to produce a concrete having the specified air content as determined by California Test 504.



#### **90-4.07 OPTIONAL USE OF AIR-ENTRAINING ADMIXTURES**

When air-entrainment has not been specified or ordered by the Engineer, the Contractor will be permitted to use an air-entraining admixture to facilitate the use of any construction procedure or equipment provided that the average air content, as determined by California Test 504, of 3 successive tests does not exceed 4 percent, and no single test value exceeds 5.5 percent. If the Contractor elects to use an air-entraining admixture in concrete for pavement, the Contractor shall so indicate at the time the Contractor designates the source of aggregate.

#### **90-4.08 BLANK**

#### **90-4.09 BLANK**

#### **90-4.10 PROPORTIONING AND DISPENSING LIQUID ADMIXTURES**

Chemical admixtures and air-entraining admixtures shall be dispensed in liquid form. Dispensers for liquid admixtures shall have sufficient capacity to measure at one time the prescribed quantity required for each batch of concrete. Each dispenser shall include a graduated measuring unit into which liquid admixtures are measured to within  $\pm 5$  percent of the prescribed quantity for each batch. Dispensers shall be located and maintained so that the graduations can be accurately read from the point at which proportioning operations are controlled to permit a visual check of batching accuracy prior to discharge. Each measuring unit shall be clearly marked for the type and quantity of admixture.

Each liquid admixture dispensing system shall be equipped with a sampling device consisting of a valve located in a safe and readily accessible position such that a sample of the admixture may be withdrawn slowly by the Engineer.

If more than one liquid admixture is used in the concrete mix, each liquid admixture shall have a separate measuring unit and shall be dispensed by injecting equipment located in such a manner that the admixtures are not mixed at high concentrations and do not interfere with the effectiveness of each other. When air-entraining admixtures are used in conjunction with other liquid admixtures, the air-entraining admixture shall be the first to be incorporated into the mix, unless it is demonstrated that a different sequence improves performance.

When automatic proportioning devices are used, dispensers for liquid admixtures shall operate automatically with the batching control equipment. The dispensers shall be equipped with an automatic warning system in good operating condition that will provide a visible or audible signal at the point at which proportioning operations are controlled when the quantity of admixture measured for each batch of concrete varies from the preselected dosage by more than 5 percent, or when the entire contents of the measuring unit are not emptied from the dispenser into each batch of concrete.

Unless liquid admixtures are added to premeasured water for the batch, their discharge into the batch shall be arranged to flow into the stream of water so that the admixtures are well dispersed throughout the batch, except that air-entraining admixtures may be dispensed directly into moist sand in the batching bins provided that adequate control of the air content of the concrete can be maintained.

Liquid admixtures requiring dosages greater than one-half gallon per cubic yard shall be considered to be water when determining the total amount of free water as specified in Section 90-6.06, "Amount of Water and Penetration."

#### **90-4.11 BLANK**

### **90-5 PROPORTIONING**

#### **90-5.01 STORAGE OF AGGREGATES**

Aggregates shall be stored or stockpiled in such a manner that separation of coarse and fine particles of each size shall be avoided and the various sizes shall not become intermixed before proportioning.

Aggregates shall be stored or stockpiled and handled in a manner that prevent contamination by foreign materials. In addition, storage of aggregates at batching or mixing facilities that are erected subsequent to the award of the contract and that furnish concrete to the project shall conform to the following:

- A. Intermingling of the different sizes of aggregates shall be positively prevented. The Contractor shall take the necessary measures to prevent intermingling. The preventive measures may include, but are not necessarily limited to, physical separation of stockpiles or construction of bulkheads of adequate length and height; and
- B. Contamination of aggregates by contact with the ground shall be positively prevented. The Contractor shall take the necessary measures to prevent contamination. The preventive measures shall include, but are

not necessarily limited to, placing aggregates on wooden platforms or on hardened surfaces consisting of portland cement concrete, asphalt concrete, or cement treated material.

In placing aggregates in storage or in moving the aggregates from storage to the weigh hopper of the batching plant, any method that may cause segregation, degradation, or the combining of materials of different gradings that will result in any size of aggregate at the weigh hopper failing to meet the grading requirements, shall be discontinued. Any method of handling aggregates that results in excessive breakage of particles shall be discontinued. The use of suitable devices to reduce impact of falling aggregates may be required by the Engineer.

#### **90-5.02 PROPORTIONING DEVICES**

Weighing, measuring, or metering devices used for proportioning materials shall conform to the requirements in Section 9-1.01, "Measurement of Quantities," and this Section 90-5.02. In addition, automatic weighing systems shall comply with the requirements for automatic proportioning devices in Section 90-5.03A, "Automatic Proportioning." Automatic devices shall be automatic to the extent that the only manual operation required for proportioning the aggregates, cement, and SCM for one batch of concrete is a single operation of a switch or starter.

For concrete pavement, aggregate and bulk cementitious material must be proportioned by weight by means of automatic proportioning devices.

Proportioning devices shall be tested as frequently as the Engineer may deem necessary to ensure their accuracy.

Weighing equipment shall be insulated against vibration or movement of other operating equipment in the plant. When the plant is in operation, the weight of each batch of material shall not vary from the weight designated by the Engineer by more than the tolerances specified herein.

Equipment for cumulative weighing of aggregate shall have a zero tolerance of  $\pm 0.5$  percent of the designated total batch weight of the aggregate. For systems with individual weigh hoppers for the various sizes of aggregate, the zero tolerance shall be  $\pm 0.5$  percent of the individual batch weight designated for each size of aggregate. Equipment for cumulative weighing of cement and SCM shall have a zero tolerance of  $\pm 0.5$  percent of the designated total batch weight of the cement and SCM. Equipment for weighing cement or SCM separately shall have a zero tolerance of  $\pm 0.5$  percent of their designated individual batch weights. Equipment for measuring water shall have a zero tolerance of  $\pm 0.5$  percent of its designated weight or volume.

The weight indicated for any batch of material shall not vary from the preselected scale setting by more than the following:

- A. Aggregate weighed cumulatively shall be within 1.0 percent of the designated total batch weight of the aggregate. Aggregates weighed individually shall be within 1.5 percent of their respective designated batch weights; and
- B. Cement shall be 99 to 102 percent of its designated batch weight. When weighed individually, SCM shall be 99 to 102 percent of its designated batch weight. When SCM and cement are permitted to be weighed cumulatively, cement shall be weighed first to 99 to 102 percent of its designated batch weight, and the total for cement and SCM shall be 99 to 102 percent of the sum of their designated batch weights. When a blended cement is used, the percentages of cement and SCM used for calculating batch weights shall be based on the percentage of SCM indicated in the Certificate of Compliance from the blended cement supplier; and
- C. Water shall be within 1.5 percent of its designated weight or volume.

Each scale graduation shall be approximately 0.001 of the total capacity of the scale. The capacity of scales for weighing cement, SCM, or cement plus SCM and aggregates shall not exceed that of commercially available scales having single graduations indicating a weight not exceeding the maximum permissible weight variation above, except that no scale shall be required having a capacity of less than 1,000 pounds, with one pound graduations.

#### **90-5.03 PROPORTIONING**

Proportioning shall consist of dividing the aggregates into the specified sizes, each stored in a separate bin, and combining them with cementitious material and water as provided in these specifications. Aggregates shall be proportioned by weight.

At the time of batching, aggregates shall have been dried or drained sufficiently to result in a stable moisture content such that no visible separation of water from aggregate will take place during transportation from the proportioning plant to the point of mixing. In no event shall the free moisture content of the fine aggregate at the time of batching exceed 8 percent of its saturated, surface-dry weight.

Should separate supplies of aggregate material of the same size group, but of different moisture content or specific gravity or surface characteristics affecting workability, be available at the proportioning plant, withdrawals shall be made from one supply exclusively and the materials therein completely exhausted before starting upon another.

Bulk Type IP (MS) or Type IS (MS) cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the ingredients are released for discharge into the mixer.

Bulk cement and SCM may be weighed in separate, individual weigh hoppers or may be weighed in the same weigh hopper and shall be kept separate from the aggregates until the ingredients are released for discharge into the mixer. If the cement and SCM are weighed cumulatively, the cement shall be weighed first.

If cement and SCM are weighed in separate weigh hoppers, the weigh systems for the proportioning of the aggregate, the cement, and the SCM shall be individual and distinct from all other weigh systems. Each weigh system shall be equipped with a hopper, a lever system, and an indicator to constitute an individual and independent material-weighing device. The cement and the SCM shall be discharged into the mixer simultaneously with the aggregate.

The scales and weigh hoppers for bulk weighing cement, SCM, or cement plus SCM shall be separate and distinct from the aggregate weighing equipment.

For batches of one cubic yard or more, the batching equipment shall conform to one of the following combinations:

- A. Separate boxes and separate scale and indicator for weighing each size of aggregate.
- B. Single box and scale indicator for all aggregates.
- C. Single box or separate boxes and automatic weighing mechanism for all aggregates.

In order to check the accuracy of batch weights, the gross weight and tare weight of batch trucks, truck mixers, truck agitators, and non-agitating hauling equipment shall be determined when ordered by the Engineer. The equipment shall be weighed on scales designated by the Engineer.

#### **90-5.03A Automatic Proportioning**

Automatic proportioning devices shall be authorized by the Department.

For concrete pavement, the Contractor shall install and maintain in operating condition an electronically actuated moisture meter that will indicate, on a readily visible scale, changes in the moisture content of the fine aggregate as it is batched within a sensitivity of 0.5 percent by weight of the fine aggregate.

The batching of cement, SCM, or cement plus SCM and aggregate shall be interlocked so that a new batch cannot be started until all weigh hoppers are empty, the proportioning devices are within zero tolerance, and the discharge gates are closed. The interlock shall permit no part of the batch to be discharged until all aggregate hoppers and the cement and SCM hoppers or the cement plus SCM hopper are charged with weights that are within the tolerances specified in Section 90-5.02, "Proportioning Devices."

If interlocks are required for cement and SCM charging mechanisms and cement and SCM are weighed cumulatively, their charging mechanisms shall be interlocked to prevent the introduction of SCM until the weight of cement in the cement weigh hopper is within the tolerances specified in Section 90-5.02, "Proportioning Devices."

If concrete is completely mixed in stationary mixers, the SCMs shall be weighed in a separate weigh hopper and the SCM and cement shall be introduced simultaneously into the mixer proportionately with the aggregate. If the Contractor provides certification that the stationary mixer is capable of mixing the cement, SCM, aggregates, and water uniformly before discharge, weighing the SCM cumulatively with the cement is permitted. Certification shall contain the following:

- A. Test results for 2 compressive strength test cylinders of concrete taken within the first one-third and 2 compressive strength test cylinders of concrete taken within the last one-third of the concrete discharged from a single batch from the stationary mixer. Strength tests and cylinder preparation will be in conformance with the provisions of Section 90-9, "Compressive Strength";
- B. Calculations demonstrating that the difference in the averages of 2 compressive strengths taken in the first one-third is no greater than 7.5 percent different than the averages of 2 compressive strengths taken in the last one-third of the concrete discharged from a single batch from the stationary mixer. Strength tests and cylinder preparation will be in conformance with the provisions of Section 90-9, "Compressive Strength;" and
- C. The mixer rotation speed and time of mixing before discharge that are required to produce a mix that meets the requirements above.

The discharge gate on the cement and SCM hoppers or the cement plus SCM hopper shall be designed to permit regulating the flow of cement, SCM, or cement plus SCM into the aggregate as directed by the Engineer.

If separate weigh boxes are used for each size of aggregate, the discharge gates shall permit regulating the flow of each size of aggregate as directed by the Engineer.

Material discharged from the several bins shall be controlled by gates or by mechanical conveyors. The means of withdrawal from the several bins, and of discharge from the weigh box, shall be interlocked so that not more than one bin can discharge at a time, and so that the weigh box cannot be tripped until the required quantity from each of the several bins has been deposited therein. Should a separate weigh box be used for each size of aggregate, all may be operated and discharged simultaneously.

If the discharge from the several bins is controlled by gates, each gate shall be actuated automatically so that the required weight is discharged into the weigh box, after which the gate shall automatically close and lock.

The automatic weighing system shall be designed so that all proportions required may be set on the weighing controller at the same time.

## **90-6 MIXING AND TRANSPORTING**

### **90-6.01 GENERAL**

Concrete shall be mixed in mechanically operated mixers, except that when permitted by the Engineer, batches not exceeding 1/3 cubic yard may be mixed by hand methods in conformance with the provisions in Section 90-6.05, "Hand-Mixing."

Equipment having components made of aluminum or magnesium alloys that would have contact with plastic concrete during mixing, transporting, or pumping of portland cement concrete shall not be used.

Concrete shall be homogeneous and thoroughly mixed, and there shall be no lumps or evidence of undispersed cementitious material.

Uniformity of concrete mixtures will be determined by differences in penetration as determined by California Test 533, or slump as determined by ASTM Designation: C 143, and by variations in the proportion of coarse aggregate as determined by California Test 529.

When the mix design specifies a penetration value, the difference in penetration, determined by comparing penetration tests on 2 samples of mixed concrete from the same batch or truck mixer load, shall not exceed 1/2 inch. When the mix design specifies a slump value, the difference in slump, determined by comparing slump tests on 2 samples of mixed concrete from the same batch or truck mixer load, shall not exceed the values given in the table below. Variation in the proportion of coarse aggregate will be determined by comparing the results of tests of 2 samples of mixed concrete from the same batch or truck mixer load and the difference between the 2 results shall not exceed 170 pounds per cubic yard of concrete.

| Average Slump         | Maximum Permissible Difference |
|-----------------------|--------------------------------|
| Less than 4"          | 1"                             |
| 4" to 6"              | 1-1/2"                         |
| Greater than 6" to 9" | 2"                             |

The Contractor shall furnish samples of the freshly mixed concrete and provide satisfactory facilities for obtaining the samples.

### **90-6.02 MACHINE MIXING**

Concrete mixers may be of the revolving drum or the revolving blade type, and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. Mixers and agitators that have an accumulation of hard concrete or mortar shall not be used.

The temperature of mixed concrete, immediately before placing, shall be not less than 50 °F or more than 90 °F. Aggregates and water shall be heated or cooled as necessary to produce concrete within these temperature limits. Neither aggregates nor mixing water shall be heated to exceed 150 °F. If ice is used to cool the concrete, discharge of the mixer will not be permitted until all ice is melted.

The batch shall be so charged into the mixer that some water will enter in advance of cementitious materials and aggregates. All water shall be in the drum by the end of the first one-fourth of the specified mixing time. When concrete is delivered in a truck mixer, a portion of the mixing water may be withheld and, if allowed by the Engineer, may be added at the point of delivery as specified under Section 90-6.03, "Transporting Mixed Concrete."

Cementitious materials shall be batched and charged into the mixer by means that will not result either in loss of cementitious materials due to the effect of wind, in accumulation of cementitious materials on surfaces of conveyors or hoppers, or in other conditions that reduce or vary the required quantity of cementitious material in the concrete mixture.

Stationary mixers shall be operated with an automatic timing device. The timing device and discharge mechanism shall be interlocked so that during normal operation no part of the batch will be discharged until the specified mixing time has elapsed.

The total elapsed time between the intermingling of damp aggregates and all cementitious materials and the start of mixing shall not exceed 30 minutes.

The size of batch shall not exceed the manufacturer's guaranteed capacity.

When producing concrete for pavement or base, suitable batch counters shall be installed and maintained in good operating condition at job site batching plants and stationary mixers. The batch counters shall indicate the exact number of batches proportioned and mixed.

Concrete shall be mixed and delivered to the job site by means of one of the following combinations of operations:

- A. Mixed completely in a stationary mixer and the mixed concrete transported to the point of delivery in truck agitators or in nonagitating hauling equipment (central-mixed concrete).
- B. Mixed partially in a stationary mixer, and the mixing completed in a truck mixer (shrink-mixed concrete).
- C. Mixed completely in a truck mixer (transit-mixed concrete).

Agitators may be truck mixers operating at agitating speed or truck agitators. Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates on which is plainly marked the various uses for which the equipment is designed, the manufacturer's guaranteed capacity of the drum or container in terms of the volume of mixed concrete and the speed of rotation of the mixing drum or blades.

Truck mixers shall be equipped with electrically or mechanically actuated revolution counters by which the number of revolutions of the drum or blades may readily be verified.

When shrink-mixed concrete is furnished, concrete that has been partially mixed at a central plant shall be transferred to a truck mixer and all requirements for transit-mixed concrete shall apply. No credit in the number of revolutions at mixing speed will be allowed for partial mixing in a central plant.

#### **90-6.03 TRANSPORTING MIXED CONCRETE**

Mixed concrete may be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturer of the equipment as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable for adequate placement and consolidation in place, and provided the mixed concrete after hauling to the delivery point conforms to the provisions in Section 90-6.01, "General."

Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity and shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

Bodies of nonagitating hauling equipment shall be constructed so that leakage of the concrete mix, or any part thereof, will not occur at any time.

Concrete hauled in open-top vehicles shall be protected during hauling against rain or against exposure to the sun for more than 20 minutes when the ambient temperature exceeds 75 °F.

No water in excess of that in the approved mix design shall be incorporated into the concrete. If approved by the Engineer, water withheld during batching may be added to the concrete at the delivery point in one operation before the discharge of more than 1/4 cubic yard. Equipment for supplying the water shall conform to Section 90-6.06, "Amount of Water and Penetration." When water is added at the point of delivery, the drum shall be revolved not less than 30 revolutions at mixing speed after the water is added and before discharge is commenced.

The rate of discharge of mixed concrete from a truck mixer or agitator shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

If a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within 1.5 hours or before 250 revolutions of the drum or blades, whichever occurs first, after the introduction of the cementitious materials to the aggregates. Under conditions contributing to quick stiffening of the concrete, or if the temperature of the concrete is 85 °F or above, the time allowed may be less than 1.5 hours. If an admixture is used to retard the set time, the temperature of the concrete shall not exceed 85 °F, the time limit shall be 2 hours, and the revolution limitation shall be 300.

If nonagitating hauling equipment is used for transporting concrete to the delivery point, discharge shall be completed within one hour after the addition of the cementitious materials to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 °F or above, the time between the introduction of cementitious materials to the aggregates and discharge shall not exceed 45 minutes.

Each load of concrete delivered at the job site shall be accompanied by a weighmaster certificate showing the mix identification number, nonrepeating load number, date and time at which the materials were batched, the total amount of water added to the load, and for transit-mixed concrete, the reading of the revolution counter at the time

the truck mixer is charged with cement. This weighmaster certificate shall also show the actual scale weights (pounds) for the ingredients batched. Theoretical or target batch weights shall not be used as a substitute for actual scale weights.

Weighmaster certificates shall be provided in printed form, or if approved by the Engineer, the data may be submitted in electronic media. Electronic media shall be presented in a tab-delimited format on a CD or DVD. Captured data, for the ingredients represented by each batch shall be "line feed, carriage return" (LFCR) and "one line, separate record" with allowances for sufficient fields to satisfy the amount of data required by these specifications.

The Contractor may furnish a weighmaster certificate accompanied by a separate certificate that lists the actual batch weights or measurements for a load of concrete provided that both certificates are imprinted with the same nonrepeating load number that is unique to the contract and delivered to the jobsite with the load.

Weighmaster certificates furnished by the Contractor shall conform to the provisions in Section 9-1.01, "Measurement of Quantities."

#### **90-6.04 TIME OR AMOUNT OF MIXING**

Mixing of concrete in stationary mixers shall continue for the required mixing time after all ingredients, except water and admixture, if added with the water, are in the mixing compartment of the mixer before any part of the batch is released. Transfer time in multiple drum mixers shall not be counted as part of the required mixing time.

The required mixing time, in stationary mixers, of concrete used for concrete structures, except minor structures, shall be not less than 90 seconds or more than 5 minutes, except that when directed by the Engineer in writing, the requirements of the following paragraph shall apply.

The required mixing time in stationary mixers, except as provided in the preceding paragraph, shall be not less than 50 seconds or more than 5 minutes.

The minimum required revolutions at the mixing speed for transit-mixed concrete shall not be less than that recommended by the mixer manufacturer, but in no case shall the number of revolutions be less than that required to consistently produce concrete conforming to the provisions for uniformity in Section 90-6.01, "General."

When a high range water-reducing admixture is added to the concrete at the job site, the total number of revolutions shall not exceed 300.

#### **90-6.05 HAND-MIXING**

Hand-mixed concrete shall be made in batches of not more than 1/3 cubic yard and shall be mixed on a watertight, level platform. The proper amount of coarse aggregate shall be measured in measuring boxes and spread on the platform and the fine aggregate shall be spread on this layer, the 2 layers being not more than one foot in total depth. On this mixture shall be spread the dry cementitious materials and the whole mass turned no fewer than 2 times dry; then sufficient clean water shall be added, evenly distributed, and the whole mass again turned no fewer than 3 times, not including placing in the carriers or forms.

#### **90-6.06 AMOUNT OF WATER AND PENETRATION**

The amount of water used in concrete mixes shall be regulated so that the penetration of the concrete as determined by California Test 533 or the slump of the concrete as determined by ASTM Designation: C 143 is within the nominal values shown in the following table. When the penetration or slump of the concrete is found to exceed the nominal values listed, the mixture of subsequent batches shall be adjusted to reduce the penetration or slump to a value within the nominal range shown. Batches of concrete with a penetration or slump exceeding the maximum values listed shall not be used in the work. If Type F or Type G chemical admixtures are added to the mix, the penetration requirements shall not apply and the slump shall not exceed 9 inches after the chemical admixtures are added.

| Type of Work                       | Nominal                 |                   | Maximum                 |                   |
|------------------------------------|-------------------------|-------------------|-------------------------|-------------------|
|                                    | Penetration<br>(inches) | Slump<br>(inches) | Penetration<br>(inches) | Slump<br>(inches) |
| Concrete Pavement                  | 0 - 1                   | —                 | 1-1/2                   | —                 |
| Non-reinforced concrete facilities | 0 - 1-1/2               | —                 | 2                       | —                 |
| Reinforced concrete structures     |                         |                   |                         |                   |
| Sections over 12 inches thick      | 0 - 1-1/2               | —                 | 2-1/2                   | —                 |
| Sections 12 inches thick or less   | 0 - 2                   | —                 | 3                       | —                 |
| Concrete placed under water        | —                       | 6 - 8             | —                       | 9                 |
| Cast-in-place concrete piles       | 2-1/2 - 3-1/2           | 5 - 7             | 4                       | 8                 |

The amount of free water used in concrete shall not exceed 310 pounds per cubic yard, plus 20 pounds for each required 100 pounds of cementitious material in excess of 550 pounds per cubic yard.

The term free water is defined as the total water in the mixture minus the water absorbed by the aggregates in reaching a saturated surface-dry condition.

If there are adverse or difficult conditions that affect the placing of concrete, the above specified penetration and free water content limitations may be exceeded providing the Contractor is granted permission by the Engineer in writing to increase the cementitious material content per cubic yard of concrete. The increase in water and cementitious material shall be at a ratio not to exceed 30 pounds of water per added 100 pounds of cementitious material per cubic yard. Full compensation for additional cementitious material and water added under these conditions shall be considered as included in the contract price paid for the concrete work involved and no additional compensation will be allowed therefor.

The equipment for supplying water to the mixer shall be constructed and arranged so that the amount of water added can be measured accurately. Any method of discharging water into the mixer for a batch shall be accurate within 1.5 percent of the quantity of water required to be added to the mix for any position of the mixer. Tanks used to measure water shall be designed so that water cannot enter while water is being discharged into the mixer and discharge into the mixer shall be made rapidly in one operation without dribbling. All equipment shall be arranged so as to permit checking the amount of water delivered by discharging into measured containers.

## **90-7 CURING CONCRETE**

### **90-7.01 METHODS OF CURING**

Newly placed concrete shall be cured by the methods specified in this Section 90-7.01 and the special provisions.

#### **90-7.01A Water Method**

The concrete shall be kept continuously wet by the application of water for a minimum curing period of 7 days after the concrete has been placed.

Cotton mats, rugs, carpets, or earth or sand blankets may be used as a curing medium to retain the moisture during the curing period.

If a curing medium consisting of cotton mats, rugs, carpets, polyethylene sheeting, polyethylene sheeting on burlap, or earth or sand blankets is to be used to retain the moisture, the entire surface of the concrete shall be kept damp by applying water with a nozzle that so atomizes the flow that a mist and not a spray is formed, until the surface of the concrete is covered with the curing medium. The moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow or wash the surface. At the expiration of the curing period, the concrete surfaces shall be cleared of all curing media.

At the option of the Contractor, a curing medium consisting of white opaque polyethylene sheeting extruded onto burlap may be used to cure concrete structures. The polyethylene sheeting shall have a minimum thickness of 4-mil, and shall be extruded onto 10-ounce burlap.

At the option of the Contractor, a curing medium consisting of polyethylene sheeting may be used to cure concrete columns. The polyethylene sheeting shall have a minimum thickness of 10-mil achieved in a single layer of material.

If the Contractor chooses to use polyethylene sheeting or polyethylene sheeting on burlap as a curing medium, these media and any joints therein shall be secured as necessary to provide moisture retention and shall be within 3 inches of the concrete at all points along the surface being cured. When these media are used, the temperature of the concrete shall be monitored during curing. If the temperature of the concrete cannot be maintained below 140° F, use of these curing media shall be disallowed.

When concrete bridge decks and flat slabs are to be cured without the use of a curing medium, the entire surface of the bridge deck or slab shall be kept damp by the application of water with an atomizing nozzle as specified above, until the concrete has set, after which the entire surface of the concrete shall be sprinkled continuously with water for a period of not less than 7 days.

#### **90-7.01B Curing Compound Method**

Surfaces of the concrete that are exposed to the air shall be sprayed uniformly with a curing compound.

Curing compounds to be used shall be as follows:

1. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class B, except the resin type shall be poly-alpha-methylstyrene.

2. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class B.
3. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class A.
4. Nonpigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class B.
5. Nonpigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class A.
6. Nonpigmented curing compound with fugitive dye conforming to the requirements in ASTM Designation: C 309, Type 1-D, Class A.

The infrared scan for the dried vehicle from curing compound (1) shall match the infrared scan on file at the Transportation Laboratory.

The loss of water for each type of curing compound, when tested in conformance with the requirements in California Test 534, shall not be more than 0.28 pounds per square yard in 24 hours.

The curing compound to be used will be specified elsewhere in these specifications or in the special provisions.

If the use of curing compound is required or permitted elsewhere in these specifications or in the special provisions and no specific kind is specified, any of the curing compounds listed above may be used.

Curing compound shall be applied at a nominal rate of one gallon per 150 square feet, unless otherwise specified.

At any point, the application rate shall be within  $\pm 50$  square feet per gallon of the nominal rate specified, and the average application rate shall be within  $\pm 25$  square feet per gallon of the nominal rate specified when tested in conformance with the requirements in California Test 535. Runs, sags, thin areas, skips, or holidays in the applied curing compound shall be evidence that the application is not satisfactory.

Curing compounds shall be applied using power operated spray equipment. The power operated spraying equipment shall be equipped with an operational pressure gage and a means of controlling the pressure. Hand spraying of small and irregular areas that are not reasonably accessible to mechanical spraying equipment, in the opinion of the Engineer, may be permitted.

The curing compound shall be applied to the concrete following the surface finishing operation, immediately before the moisture sheen disappears from the surface, but before any drying shrinkage or craze cracks begin to appear. In the event of any drying or cracking of the surface, application of water with an atomizing nozzle as specified in Section 90-7.01A, "Water Method," shall be started immediately and shall be continued until application of the compound is resumed or started; however, the compound shall not be applied over any resulting freestanding water. Should the film of compound be damaged from any cause before the expiration of 7 days after the concrete is placed in the case of structures and 72 hours in the case of pavement, the damaged portion shall be repaired immediately with additional compound.

At the time of use, compounds containing pigments shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. A paddle shall be used to loosen all settled pigment from the bottom of the container, and a power driven agitator shall be used to disperse the pigment uniformly throughout the vehicle.

Agitation shall not introduce air or other foreign substance into the curing compound.

The manufacturer shall include in the curing compound the necessary additives for control of sagging, pigment settling, leveling, de-emulsification, or other requisite qualities of a satisfactory working material. Pigmented curing compounds shall be manufactured so that the pigment does not settle badly, does not cake or thicken in the container, and does not become granular or curdled. Settlement of pigment shall be a thoroughly wetted, soft, mushy mass permitting the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with minimum resistance to the sideways manual motion of the paddle across the bottom of the container, to form a smooth uniform product of the proper consistency.

Curing compounds shall remain sprayable at temperatures above 40 °F and shall not be diluted or altered after manufacture.

The curing compound shall be packaged in clean 274-gallon totes, 55-gallon barrels or 5-gallon pails shall be supplied from a suitable storage tank located at the jobsite. The containers shall comply with "Title 49, Code of Federal Regulations, Hazardous Materials Regulations." The 274-gallon totes and the 55-gallon barrels shall have removable lids and airtight fasteners. The 5-gallon pails shall be round and have standard full open head and bail. Lids with bungholes will not be permitted. Settling or separation of solids in containers, except tanks, must be completely redispersed with low speed mixing prior to use, in conformance with these specifications and the manufacturer's recommendations. Mixing shall be accomplished either manually by use of a paddle or by use of a mixing blade driven by a drill motor, at low speed. Mixing blades shall be the type used for mixing paint. On-site storage tanks shall be kept clean and free of contaminants. Each tank shall have a permanent system designed to completely redisperse settled material without introducing air or other foreign substances.



Steel containers and lids shall be lined with a coating that will prevent destructive action by the compound or chemical agents in the air space above the compound. The coating shall not come off the container or lid as skins. Containers shall be filled in a manner that will prevent skinning. Plastic containers shall not react with the compound.

Each container shall be labeled with the manufacturer's name, kind of curing compound, batch number, volume, date of manufacture, and volatile organic compound (VOC) content. The label shall also warn that the curing compound containing pigment shall be well stirred before use. Precautions concerning the handling and the application of curing compound shall be shown on the label of the curing compound containers in conformance with the Construction Safety Orders and General Industry Safety Orders of the State.

Containers of curing compound shall be labeled to indicate that the contents fully comply with the rules and regulations concerning air pollution control in the State.

When the curing compound is shipped in tanks or tank trucks, a shipping invoice shall accompany each load. The invoice shall contain the same information as that required herein for container labels.

Curing compound will be sampled by the Engineer at the source of supply, at the job site, or at both locations.

Curing compound shall be formulated so as to maintain the specified properties for a minimum of one year. The Engineer may require additional testing before use to determine compliance with these specifications if the compound has not been used within one year or whenever the Engineer has reason to believe the compound is no longer satisfactory.

Tests will be conducted in conformance with the latest ASTM test methods and methods in use by the Transportation Laboratory.

#### **90-7.01C Waterproof Membrane Method**

The exposed finished surfaces of concrete shall be sprayed with water, using a nozzle that so atomizes the flow that a mist and not a spray is formed, until the concrete has set, after which the curing membrane, shall be placed. The curing membrane shall remain in place for a period of not less than 72 hours.

Sheeting material for curing concrete shall conform to the requirements in AASHTO Designation: M 171 for white reflective materials.

The sheeting material shall be fabricated into sheets of such width as to provide a complete cover for the entire concrete surface. Joints in the sheets shall be securely cemented together in such a manner as to provide a waterproof joint. The joint seams shall have a minimum lap of 0.33 foot.

The sheets shall be securely weighted down by placing a bank of earth on the edges of the sheets or by other means satisfactory to the Engineer.

Should any portion of the sheets be broken or damaged before the expiration of 72 hours after being placed, the broken or damaged portions shall be immediately repaired with new sheets properly cemented into place.

Sections of membrane that have lost their waterproof qualities or have been damaged to such an extent as to render them unfit for curing the concrete shall not be used.

#### **90-7.01D Forms-In-Place Method**

Formed surfaces of concrete may be cured by retaining the forms in place. The forms shall remain in place for a minimum period of 7 days after the concrete has been placed, except that for members over 20 inches in least dimension the forms shall remain in place for a minimum period of 5 days.

Joints in the forms and the joints between the end of forms and concrete shall be kept moisture tight during the curing period. Cracks in the forms and cracks between the forms and the concrete shall be resealed by methods subject to the approval of the Engineer.

#### **90-7.02 BLANK**

#### **90-7.03 CURING STRUCTURES**

Newly placed concrete for cast-in-place structures, other than highway bridge decks, shall be cured by the water method, the forms-in-place method, or, as permitted herein, by the curing compound method, in conformance with the provisions in Section 90-7.01, "Methods of Curing."

The curing compound method using a pigmented curing compound may be used on concrete surfaces of construction joints, surfaces that are to be buried underground, and surfaces where only ordinary surface finish is to be applied and on which a uniform color is not required and that will not be visible from a public traveled way. If the Contractor elects to use the curing compound method on the bottom slab of box girder spans, the curing compound shall be curing compound (1).

The top surface of highway bridge decks shall be cured by both the curing compound method and the water method. The curing compound shall be curing compound (1).

Concrete surfaces of minor structures, as defined in Section 51-1.02, "Minor Structures," shall be cured by the water method, the forms-in-place method or the curing compound method.

When deemed necessary by the Engineer during periods of hot weather, water shall be applied to concrete surfaces being cured by the curing compound method or by the forms-in-place method, until the Engineer determines that a cooling effect is no longer required. Application of water for this purpose will be paid for as extra work as provided in Section 4-1.03D, "Extra Work."

#### **90-7.04 CURING PRECAST CONCRETE MEMBERS**

Precast concrete members shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing." Curing shall be provided for the minimum time specified for each method or until the concrete reaches its design strength, whichever is less. Steam curing may also be used for precast members and shall conform to the following provisions:

- A. After placement of the concrete, members shall be held for a minimum 4-hour presteaming period. If the ambient air temperature is below 50 °F, steam shall be applied during the presteaming period to hold the air surrounding the member at a temperature between 50 °F and 90 °F.
- B. To prevent moisture loss on exposed surfaces during the presteaming period, members shall be covered as soon as possible after casting or the exposed surfaces shall be kept wet by fog spray or wet blankets.
- C. Enclosures for steam curing shall allow free circulation of steam about the member and shall be constructed to contain the live steam with a minimum moisture loss. The use of tarpaulins or similar flexible covers will be permitted, provided they are kept in good repair and secured in such a manner as to prevent the loss of steam and moisture.
- D. Steam at the jets shall be at low pressure and in a saturated condition. Steam jets shall not impinge directly on the concrete, test cylinders, or forms. During application of the steam, the temperature rise within the enclosure shall not exceed 40 °F per hour. The curing temperature throughout the enclosure shall not exceed 150 °F and shall be maintained at a constant level for a sufficient time necessary to develop the required transfer strength. Control cylinders shall be covered to prevent moisture loss and shall be placed in a location where temperature is representative of the average temperature of the enclosure.
- E. Temperature recording devices that will provide an accurate, continuous, permanent record of the curing temperature shall be provided. A minimum of one temperature recording device per 200 feet of continuous bed length will be required for checking temperature.
- F. Members in pretension beds shall be detensioned immediately after the termination of steam curing while the concrete and forms are still warm, or the temperature under the enclosure shall be maintained above 60 °F until the stress is transferred to the concrete.
- G. Curing of precast concrete will be considered completed after termination of the steam curing cycle.

#### **90-7.05 CURING PRECAST PRESTRESSED CONCRETE PILES**

Newly placed concrete for precast prestressed concrete piles shall be cured in conformance with the provisions in Section 90-7.04, "Curing Precast Concrete Members," except that piles in a corrosive environment shall be cured as follows:

- A. Piles shall be either steam cured or water cured. If water curing is used, the piles shall be kept continuously wet by the application of water in conformance with the provisions in Section 90-7.01A, "Water Method."
- B. If steam curing is used, the steam curing provisions in Section 90-7.04, "Curing Precast Concrete Members," shall apply except that the piles shall be kept continuously wet for their entire length for a period of not less than 3 days, including the holding and steam curing periods.

#### **90-7.06 CURING SLOPE PROTECTION**

Concrete slope protection shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing."

Concreted-rock slope protection shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing," with a blanket of earth kept wet for 72 hours, or by sprinkling with a fine spray of water every 2 hours during the daytime for a period of 3 days.

#### **90-7.07 CURING MISCELLANEOUS CONCRETE WORK**

Exposed surfaces of curbs shall be cured by pigmented curing compounds as specified in Section 90-7.01B, "Curing Compound Method."

Concrete sidewalks, gutter depressions, island paving, curb ramps, driveways, and other miscellaneous concrete areas shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing."

Shotcrete shall be cured for at least 72 hours by spraying with water, by a moist earth blanket, or by any of the methods provided in Section 90-7.01, "Methods of Curing."

Mortar and grout shall be cured by keeping the surface damp for 3 days.

After placing, the exposed surfaces of sign structure foundations, including pedestal portions, if constructed, shall be cured for at least 72 hours by spraying with water, by a moist earth blanket, or by any of the methods provided in Section 90-7.01, "Methods of Curing."

## **90-8 PROTECTING CONCRETE**

### **90-8.01 GENERAL**

In addition to the provisions in Section 7-1.16, "Contractor's Responsibility for the Work and Materials," the Contractor shall protect concrete as provided in this Section 90-8. If required by the Engineer, the Contractor shall submit a written outline of the proposed methods for protecting the concrete.

The Contractor shall protect concrete from damage from any cause, which shall include, but not be limited to: rain, heat, cold, wind, Contractor's actions, and actions of others.

Concrete shall not be placed on frozen or ice-coated ground or subgrade nor on ice-coated forms, reinforcing steel, structural steel, conduits, precast members, or construction joints.

Under rainy conditions, placing of concrete shall be stopped before the quantity of surface water is sufficient to damage surface mortar or cause a flow or wash of the concrete surface, unless the Contractor provides adequate protection against damage.

Concrete that has been frozen or damaged by other causes, as determined by the Engineer, shall be removed and replaced by the Contractor at the Contractor's expense.

### **90-8.02 PROTECTING CONCRETE STRUCTURES**

Structure concrete and shotcrete used as structure concrete shall be maintained at a temperature of not less than 45 °F for 72 hours after placing and at not less than 40 °F for an additional 4 days.

## **90-9 COMPRESSIVE STRENGTH**

### **90-9.01 GENERAL**

Concrete compressive strength requirements consist of a minimum strength that shall be attained before various loads or stresses are applied to the concrete and, for concrete designated by compressive strength, a minimum strength at the age of 28 days or at the age otherwise allowed in Section 90-1.01, "Description." The various strengths required are specified in these specifications or the special provisions or are shown on the plans.

The compressive strength of concrete will be determined from test cylinders that have been fabricated from concrete sampled in conformance with the requirements of California Test 539. Test cylinders will be molded and initially field cured in conformance with California Test 540. Test cylinders will be cured and tested after receipt at the testing laboratory in conformance with the requirements of California Test 521. A strength test shall consist of the average strength of 2 cylinders fabricated from material taken from a single load of concrete, except that, if any cylinder should show evidence of improper sampling, molding, or testing, that cylinder shall be discarded and the strength test shall consist of the strength of the remaining cylinder.

When concrete compressive strength is specified as a prerequisite to applying loads or stresses to a concrete structure or member, test cylinders for other than steam cured concrete will be cured in conformance with Method 1 of California Test 540. The compressive strength of concrete determined for these purposes will be evaluated on the basis of individual tests.

When concrete is designated by compressive strength rather than by cementitious material content, the concrete strength to be used as a basis for acceptance of other than steam cured concrete will be determined from cylinders cured in conformance with Method 1 of California Test 540. If the result of a single compressive strength test at the maximum age specified or allowed is below the specified strength but is 95 percent or more of the specified strength, the Contractor shall make corrective changes, subject to approval of the Engineer, in the mix proportions or in the concrete fabrication procedures, before placing additional concrete, and shall pay to the State \$10 for each in-place cubic yard of concrete represented by the deficient test. If the result of a single compressive strength test at the maximum age specified or allowed is below 95 percent of the specified strength, but is 85 percent or more of the specified strength, the Contractor shall make the corrective changes specified above, and shall pay to the State \$15 for each in-place cubic yard of concrete represented by the deficient test. In addition, such corrective changes shall be made when the compressive strength of concrete tested at 7 days indicates, in the judgment of the Engineer, that the concrete will not attain the required compressive strength at the maximum age specified or allowed. Concrete

represented by a single test that indicates a compressive strength of less than 85 percent of the specified 28-day compressive strength will be rejected in conformance with the provisions in Section 6-1.04, "Defective Materials."

If the test result indicates that the compressive strength at the maximum age specified or allowed is below the specified strength, but is 85 percent or more of the specified strength, payments to the State as required above shall be made, unless the Contractor, at the Contractor's expense, obtains and submits evidence acceptable to the Engineer that the strength of the concrete placed in the work meets or exceeds the specified 28-day compressive strength. If the test result indicates a compressive strength at the maximum age specified or allowed below 85 percent, the concrete represented by that test will be rejected, unless the Contractor, at the Contractor's expense, obtains and submits evidence acceptable to the Engineer that the strength of the concrete placed in the work is at least 85 percent of the specified strength. If the evidence consists of tests made on cores taken from the work, the cores shall be obtained and tested in conformance with the requirements in ASTM Designation: C 42.

No single compressive strength test shall represent more than 320 cubic yards.

If a precast concrete member is steam cured, the compressive strength of the concrete will be determined from test cylinders that have been handled and stored in conformance with Method 3 of California Test 540. The compressive strength of steam cured concrete will be evaluated on the basis of individual tests representing specific portions of production. If the concrete is designated by 28-day compressive strength rather than by cementitious material content, the concrete shall be considered to be acceptable whenever its compressive strength reaches the specified 28-day compressive strength provided that strength is reached in not more than the maximum number of days specified or allowed after the member is cast.

When concrete has a specified 28-day compressive strength greater than 3,600 pounds per square inch or when prequalification is specified, prequalification of materials, mix proportions, mixing equipment, and procedures proposed for use will be required prior to placement of the concrete. Prequalification shall be accomplished by the submission of acceptable certified test data or trial batch reports by the Contractor. Prequalification data shall be based on the use of materials, mix proportions, mixing equipment, procedures, and size of batch proposed for use in the work.

Certified test data, in order to be acceptable, shall indicate that not less than 90 percent of at least 20 consecutive tests exceed the specified strength at the maximum number of days specified or allowed, and none of those tests are less than 95 percent of specified strength. Strength tests included in the data shall be the most recent tests made on concrete of the proposed mix design and all shall have been made within one year of the proposed use of the concrete.

Trial batch test reports, in order to be acceptable, shall indicate that the average compressive strength of 5 consecutive concrete cylinders, taken from a single batch, at not more than 28 days (or the maximum age allowed) after molding shall be at least 600 pounds per square inch greater than the specified 28-day compressive strength, and no individual cylinder shall have a strength less than the specified strength at the maximum age specified or allowed. Data contained in the report shall be from trial batches that were produced within one year of the proposed use of specified strength concrete in the project. Whenever air-entrainment is required, the air content of trial batches shall be equal to or greater than the air content specified for the concrete without reduction due to tolerances.

Tests shall be performed in conformance with either the appropriate California Test methods or the comparable ASTM test methods. Equipment employed in testing shall be in good condition and shall be properly calibrated. If the tests are performed during the life of the contract, the Engineer shall be notified sufficiently in advance of performing the tests in order to witness the test procedures.

The certified test data and trial batch test reports shall include the following information:

- A. Date of mixing.
- B. Mixing equipment and procedures used.
- C. The size of batch in cubic yards and the weight, type, and source of all ingredients used.
- D. Penetration or slump (if the concrete will be placed under water or placed in cast-in-place concrete piles) of the concrete.
- E. The air content of the concrete if an air-entraining admixture is used.
- F. The age at time of testing and strength of all concrete cylinders tested.

Certified test data and trial batch test reports shall be signed by an official of the firm that performed the tests.

When approved by the Engineer, concrete from trial batches may be used in the work at locations where concrete of a lower quality is required and the concrete will be paid for as the type of concrete required at that location.

After materials, mix proportions, mixing equipment, and procedures for concrete have been prequalified for use, additional prequalification by testing of trial batches will be required prior to making changes that, in the judgment of the Engineer, could result in a strength of concrete below that specified.

The Contractor's attention is directed to the time required to test trial batches and the Contractor shall be responsible for production of trial batches at a sufficiently early date so that the progress of the work is not delayed.

When precast concrete members are manufactured at the plant of an established manufacturer of precast concrete members, the mix proportions of the concrete shall be determined by the Contractor, and a trial batch and prequalification of the materials, mix proportions, mixing equipment, and procedures will not be required.

## **90-10 MINOR CONCRETE**

### **90-10.01 GENERAL**

Concrete for minor structures, slope paving, curbs, sidewalks and other concrete work, when designated as minor concrete on the plans, in the specifications, or in the contract item, shall conform to the provisions specified herein.

The Engineer, at the Engineer's discretion, will inspect and test the facilities, materials and methods for producing the concrete to ensure that minor concrete of the quality suitable for use in the work is obtained.

Before using minor concrete or in advance of revising the mix proportions, the Contractor shall submit in writing to the Engineer a copy of the mix design. When required by the following table, the Contractor shall include compressive strength test results verifying the minimum specified compressive strength:

| SCM                         | Test Submittal Required                   |
|-----------------------------|---|
| Fly Ash used alone          | When portland cement content < 350 lbs/cy |
| GGBFS used alone            | When portland cement content < 250 lbs/cy |
| Natural Pozzolan used alone | When portland cement content < 350 lbs/cy |
| More than 1 SCM             | Always                                    |

Tests shall be performed by an ACI certified technician.

### **90-10.02 MATERIALS**

Minor concrete shall conform to the following requirements:

#### **90-10.02A Cementitious Material**

Cementitious material shall conform to the provisions in Section 90-1.01, "Description," and 90-2, "Materials."

#### **90-10.02B Aggregate**

Aggregate shall be clean and free from deleterious coatings, clay balls, roots, and other extraneous materials.

Use of crushed concrete or reclaimed aggregate is acceptable only if the aggregate satisfies all aggregate requirements.

The Contractor shall submit to the Engineer for approval, a grading of the combined aggregate proposed for use in the minor concrete. After acceptance of the grading, aggregate furnished for minor concrete shall conform to that grading, unless a change is authorized in writing by the Engineer.

The Engineer may require the Contractor to furnish periodic test reports of the aggregate grading furnished. The maximum size of aggregate used shall be at the option of the Contractor, but in no case shall the maximum size be larger than 1-1/2-inch or smaller than 3/4 inch.

The Engineer may waive, in writing, the gradation requirements in this Section 90-10.02B, if, in the Engineer's opinion, the furnishing of the gradation is not necessary for the type or amount of concrete work to be constructed.

#### **90-10.02C Water**

Water used for washing, mixing, and curing shall be free from oil, salts, and other impurities that would discolor or etch the surface or have an adverse affect on the quality of the concrete.

#### **90-10.02D Admixtures**

The use of admixtures shall conform to the provisions in Section 90-4, "Admixtures."

### **90-10.03 PRODUCTION**

Cementitious material, water, aggregate, and admixtures shall be stored, proportioned, mixed, transported, and discharged in conformance with recognized standards of good practice that will result in concrete that is thoroughly and uniformly mixed, that is suitable for the use intended, and that conforms to requirements specified herein. Recognized standards of good practice are outlined in various industry publications such as are issued by American Concrete Institute, AASHTO, or the Department.

The cementitious material content of minor concrete shall conform to the provisions in Section 90-1.01, "Description."

The amount of water used shall result in a consistency of concrete conforming to the provisions in Section 90-6.06, "Amount of Water and Penetration." Additional mixing water shall not be incorporated into the concrete during hauling or after arrival at the delivery point, unless allowed by the Engineer.

Discharge of ready-mixed concrete from the transporting vehicle shall be made while the concrete is still plastic and before stiffening occurs. An elapsed time of 1.5 hours (one hour in non-agitating hauling equipment), or more than 250 revolutions of the drum or blades, after the introduction of the cementitious material to the aggregates, or a temperature of concrete of more than 90 °F will be considered conditions contributing to the quick stiffening of concrete. The Contractor shall take whatever action is necessary to eliminate quick stiffening, except that the addition of water will not be permitted.

The required mixing time in stationary mixers shall be not less than 50 seconds or more than 5 minutes.

The minimum required revolutions at mixing speed for transit-mixed concrete shall be not less than that recommended by the mixer manufacturer, and shall be increased, if necessary, to produce thoroughly and uniformly mixed concrete.

When a high range water-reducing admixture is added to the concrete at the job site, the total number of revolutions shall not exceed 300.

Each load of ready-mixed concrete shall be accompanied by a weighmaster certificate that shall be delivered to the Engineer at the discharge location of the concrete, unless otherwise directed by the Engineer. The weighmaster certificate shall be clearly marked with the date and time of day when the load left the batching plant and, if hauled in truck mixers or agitators, the time the mixing cycle started.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," shall be furnished to the Engineer, prior to placing minor concrete from a source not previously used on the contract, stating that minor concrete to be furnished meets contract requirements, including minimum cementitious material content specified.

### **90-10.04 CURING MINOR CONCRETE**

Curing minor concrete shall conform to the provisions in Section 90-7, "Curing Concrete."

### **90-10.05 PROTECTING MINOR CONCRETE**

Protecting minor concrete shall conform to the provisions in Section 90-8, "Protecting Concrete," except the concrete shall be maintained at a temperature of not less than 40 °F for 72 hours after placing.

### **90-10.06 MEASUREMENT AND PAYMENT**

Minor concrete will be measured and paid for in conformance with the provisions specified in the various sections of these specifications covering concrete construction when minor concrete is specified in the specifications, shown on the plans, or indicated by contract item in the Engineer's Estimate.

## **90-11 MEASUREMENT AND PAYMENT**

### **90-11.01 MEASUREMENT**

Portland cement concrete will be measured in conformance with the provisions specified in the various sections of these specifications covering construction requiring concrete.

For concrete measured at the mixer, the volume in cubic feet shall be computed as the total weight of the batch in pounds divided by the density of the concrete in pounds per cubic foot. The total weight of the batch shall be calculated as the sum of all materials, including water, entering the batch. The density of the concrete will be determined in conformance with the requirements in California Test 518.

### **90-11.02 PAYMENT**

Portland cement concrete will be paid for in conformance with the provisions specified in the various sections of these specifications covering construction requiring concrete.



This paint may be tinted by using "universal" or "all purpose" concentrates.

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## **SECTION 92 ASPHALTS**

**(Issued 01-20-12)**

**Replace Section 92 with:**

## **SECTION 92 ASPHALTS**

### **92-1.01 DESCRIPTION**

Asphalt is refined petroleum or a mixture of refined liquid asphalt and refined solid asphalt that are prepared from crude petroleum. Asphalt is:

1. Free from residues caused by the artificial distillation of coal, coal tar, or paraffin
2. Free from water
3. Homogeneous

### **92-1.02 MATERIALS**

#### **GENERAL**

Furnish asphalt under the Department's "Certification Program for Suppliers of Asphalt." The Department maintains the program requirements, procedures, and a list of approved suppliers at:

<http://www.dot.ca.gov/hq/esc/Translab/fpm/fpmcoc.htm>

Transport, store, use, and dispose of asphalt safely.

Prevent the formation of carbonized particles caused by overheating asphalt during manufacturing or construction.

#### **GRADES**

Performance graded (PG) asphalt binder is:



**Performance Graded Asphalt Binder**

| Property   | AASHTO<br>Test<br>Method | Specification            |                         |                         |                         |                         |
|--|--------------------------|--------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|  |                          | Grade                    |                         |                         |                         |                         |
|  |                          | PG<br>58-22 <sup>a</sup> | PG<br>64-10             | PG<br>64-16             | PG<br>64-28             | PG<br>70-10             |
| Original Binder  |                          |                          |                         |                         |                         |                         |
| Flash Point, Minimum °C  | T 48                     | 230                      | 230                     | 230                     | 230                     | 230                     |
| Solubility, Minimum % <sup>b</sup>   | T 44                     | 99                       | 99                      | 99                      | 99                      | 99                      |
| Viscosity at 135°C, <sup>c</sup><br>Maximum, Pa·s  | T 316                    | 3.0                      | 3.0                     | 3.0                     | 3.0                     | 3.0                     |
| Dynamic Shear,<br>Test Temp. at 10 rad/s, °C<br>Minimum G*/sin(delta), kPa<br>Maximum G*/sin(delta), kPa | T 315                    | 58<br>1.00<br>2.00       | 64<br>1.00<br>2.00      | 64<br>1.00<br>2.00      | 64<br>1.00<br>2.00      | 70<br>1.00<br>2.00      |
| RTFO Test, <sup>e</sup><br>Mass Loss, Maximum, %   | T 240                    | 1.00                     | 1.00                    | 1.00                    | 1.00                    | 1.00                    |
| RTFO Test Aged Binder  |                          |                          |                         |                         |                         |                         |
| Dynamic Shear,<br>Test Temp. at 10 rad/s, °C<br>Minimum G*/sin(delta), kPa                               | T 315                    | 58<br>2.20               | 64<br>2.20              | 64<br>2.20              | 64<br>2.20              | 70<br>2.20              |
| Ductility at 25°C<br>Minimum, cm   | T 51                     | 75                       | 75                      | 75                      | 75                      | 75                      |
| PAV <sup>f</sup> Aging,<br>Temperature, °C   | R 28                     | 100                      | 100                     | 100                     | 100                     | 110                     |
| RTFO Test and PAV Aged Binder  |                          |                          |                         |                         |                         |                         |
| Dynamic Shear,<br>Test Temp. at 10 rad/s, °C<br>Maximum G*/sin(delta), kPa                               | T 315                    | 22 <sup>d</sup><br>5000  | 31 <sup>d</sup><br>5000 | 28 <sup>d</sup><br>5000 | 22 <sup>d</sup><br>5000 | 34 <sup>d</sup><br>5000 |
| Creep Stiffness,<br>Test Temperature, °C<br>Maximum S-value, Mpa<br>Minimum M-value                      | T 313                    | -12<br>300<br>0.300      | 0<br>300<br>0.300       | -6<br>300<br>0.300      | -18<br>300<br>0.300     | 0<br>300<br>0.300       |

**Notes:**

- Use as asphalt rubber base stock for high mountain and high desert area.
- The Engineer waives this specification if the supplier is a Quality Supplier as defined by the Department's "Certification Program for Suppliers of Asphalt."
- The Engineer waives this specification if the supplier certifies the asphalt binder can be adequately pumped and mixed at temperatures meeting applicable safety standards.
- Test the sample at 3°C higher if it fails at the specified test temperature. G\*/sin(delta) remains 5000 kPa maximum.
- "RTFO Test" means the asphaltic residue obtained using the Rolling Thin Film Oven Test, AASHTO Test Method T 240 or ASTM Designation: D 2872. The residue from mass change determination may be used for other tests.
- "PAV" means Pressurized Aging Vessel.

Performance graded polymer modified asphalt binder (PG Polymer Modified) is:

**Performance Graded Polymer Modified Asphalt Binder <sup>a</sup>**

| Property  | AASHTO Test Method | Specification Grade |                     |                     |
|---|--------------------|---------------------|---------------------|---------------------|
|   |                    | PG<br>58-34 PM      | PG<br>64-28 PM      | PG<br>76-22 PM      |
| Original Binder   |                    |                     |                     |                     |
| Flash Point, Minimum °C   | T 48               | 230                 | 230                 | 230                 |
| Solubility, Minimum % <sup>b</sup>  | T 44 <sup>c</sup>  | 98.5                | 98.5                | 98.5                |
| Viscosity at 135°C, <sup>d</sup><br>Maximum, Pa·s                                   | T 316              | 3.0                 | 3.0                 | 3.0                 |
| Dynamic Shear,<br>Test Temp. at 10 rad/s, °C<br>Minimum G*/sin(delta), kPa          | T 315              | 58<br>1.00          | 64<br>1.00          | 76<br>1.00          |
| RTFO Test ,<br>Mass Loss, Maximum, %  | T 240              | 1.00                | 1.00                | 1.00                |
| RTFO Test Aged Binder   |                    |                     |                     |                     |
| Dynamic Shear,<br>Test Temp. at 10 rad/s, °C<br>Minimum G*/sin(delta), kPa          | T 315              | 58<br>2.20          | 64<br>2.20          | 76<br>2.20          |
| Dynamic Shear,<br>Test Temp. at 10 rad/s, °C<br>Maximum (delta), %                  | T 315              | Note e<br>80        | Note e<br>80        | Note e<br>80        |
| Elastic Recovery <sup>f</sup> ,<br>Test Temp., °C<br>Minimum recovery, %            | T 301              | 25<br>75            | 25<br>75            | 25<br>65            |
| PAV <sup>g</sup> Aging,<br>Temperature, °C  | R 28               | 100                 | 100                 | 110                 |
| RTFO Test and PAV Aged Binder   |                    |                     |                     |                     |
| Dynamic Shear,<br>Test Temp. at 10 rad/s, °C<br>Maximum G*sin(delta), kPa           | T 315              | 16<br>5000          | 22<br>5000          | 31<br>5000          |
| Creep Stiffness,<br>Test Temperature, °C<br>Maximum S-value, MPa<br>Minimum M-value | T 313              | -24<br>300<br>0.300 | -18<br>300<br>0.300 | -12<br>300<br>0.300 |

**Notes:**

- Do not modify PG Polymer Modified using acid modification.
- The Engineer waives this specification if the supplier is a Quality Supplier as defined by the Department's "Certification Program for Suppliers of Asphalt."
- The Department allows ASTM D 5546 instead of AASHTO T 44
- The Engineer waives this specification if the supplier certifies the asphalt binder can be adequately pumped and mixed at temperatures meeting applicable safety standards.
- Test temperature is the temperature at which G\*/sin(delta) is 2.2 kPa. A graph of log G\*/sin(delta) plotted against temperature may be used to determine the test temperature when G\*/sin(delta) is 2.2 kPa. A graph of (delta) versus temperature may be used to determine delta at the temperature when G\*/sin(delta) is 2.2 kPa. The Engineer also accepts direct measurement of (delta) at the temperature when G\*/sin(delta) is 2.2 kPa.
- Tests without a force ductility clamp may be performed.
- "PAV" means Pressurized Aging Vessel.

**SAMPLING**

Provide a sampling device in the asphalt feed line connecting the plant storage tanks to the asphalt weighing system or spray bar. Make the sampling device accessible between 24 and 30 inches above the platform. Provide a receptacle for flushing the sampling device.

Include with the sampling device a valve:

- Between 1/2 and 3/4 inch in diameter



**Replace the table in Section 95-2.11 with:**

**Characteristics of Adhesive:**

| Test <sup>a</sup>   | California Test  | Requirement |
|---|--|-------------|
| Brookfield Viscosity, No. 3 Spindle at 20 rpm, Poise at 77°F                          | 434, Part 4  | 0.9 max.    |
| Gel time, minutes   | 434, Part 1  | 2 to 15     |
| Slant Shear Strength on Dry Concrete, psi, after 4 days of cure in air at 77° F ±2° F | 434, Part 5 <sup>b</sup>                                     | 3,000 min.  |
| Slant Shear Strength on Wet Concrete, psi, after 4 days of cure in air at 77° F ±2° F | 434, Part 5 <sup>b</sup>                                     | 1,700 min.  |
| Tensile Strength, psi   | 434, Part 7, except test after 4 days of cure at 77° F ±2° F | 4,500 min.  |
| Elongation, %   | 434, Part 7, except test after 4 days of cure at 77° F ±2° F | 10 max.     |

<sup>a</sup> The mixing ratio used will be that recommended by the manufacturer.

<sup>b</sup> For slant shear strength on concrete, delete Sections B-1 and B-5 of California Test 434, Part 5. For dry concrete, use Step "2" below only. For wet concrete, use both Steps "1" & "2":

1. Soak blocks in water for 24 hours at 77° F ±2° F. Remove and wipe off excess water.
2. Mix epoxy as described in California Test 434, Part 1, and apply a coat approximately 0.010-inch thick to each diagonal surface. Place four 0.125-inch square pieces of shim stock 0.012-inch thick on one block to control final film thickness. Before pressing the coated surfaces together, leave the blocks so that the coated surfaces are horizontal until the epoxy reacts slightly to prevent excessive flow.